# Dealing with Change:

# Indigenous Knowledge and Adaptation to Climate Change in the Ngono River Basin, Tanzania

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**Summary**

This thesis investigates the role of indigenous knowledge in dealing with climate change. For the purposes of this thesis, indigenous knowledge consists of everyday experiences, learning processes, and practices that have been gained by local communities through their daily experiences of living with nature. This thesis focuses on the case of the Haya living in the Ngono River Basin in north-western Tanzania, an area with recurrent impacts of different on-going climatic and non-climatic changes. It points out that vulnerability in the study area is not caused only by climate change, but also by different on-going changes, which intersect and produce risks among the rural poor. Informed by empirical data, a particular emphasis is placed on climate change related risks, such as long drought seasons, reduced precipitation, and incidences of strong winds. In view of these risks, this thesis examines how indigenous knowledge might help local communities to adapt to climate change. However, this knowledge is neither rigid nor static, but dynamically shaped by external influences and socio-cultural transformation. In order to understand how the indigenous knowledge of the Haya is learned, shared, and transmitted within the community, this thesis uses the Situated Learning Theory (SLT). This theory provides the framework for an in-depth exploration of knowledge acquisition process within a certain community that considers the socio-cultural context of the learners. SLT considers learning to be a fundamentally social phenomenon, which occurs through everyday interactions.

The thesis builds on eight months of fieldwork carried out in two phases: August to December 2013, and September to November 2014. The sample size for questionnaires and interviews was either randomly or purposively selected. For the selection of individuals at the village level, random selection was used to obtain a sample for the questionnaires. This was done with the assistance of village leaders using village register book. 291 household heads were randomly selected for the questionnaire sample. In addition, 48 interviews with local communities and 18 focus group discussions were conducted in selected villages of Ngono River Basin. Interviewees were able to discuss different issues, such as different on-going changes they had experienced in the last 30 years, as well as long-term adaptation practices used to deal with these changes. Furthermore, documentary review, participant observation, expert interviews, resource mapping, transect walks, and history timelines were used to obtain empirical data. The data was analysed both qualitatively and quantitatively. There are four major observations that were drawn from this research:

1. The Haya people have experienced new and recurrent changes which contribute to their vulnerability. These changes are agricultural, economic, socio-cultural and environmental in nature. Although some of these changes were beneficial to local communities, the evidence indicates that these changes have also undermined the Haya's adaptive capacity in relation to climate and non-climate related changes.
2. Irrespective of these different changes, the Haya perceive climate change as the main driver of their vulnerability, because their livelihoods depend on nature to a great extent.
3. The Haya possess a repertoire of practices embedded in the socio-cultural context of the region, which have assisted them in responding to recurrent climate change risks. The dominant practices include wetland cultivation during long drought season, growing early maturing crops, and the use of locally made pesticides.
4. Fourth, the intersection of indigenous knowledge and western knowledge in adaptation brings forward questions of power. Within the community there are struggles over what constitutes "best practices" for adaptation. In particular, the evidence indicates that there is a power imbalance between extension staff and other members of the community. Most of the extension staffs recommend the use of western knowledge for climate change adaptation, which is often rejected by other parts of the community, as western knowledge sometimes does not fit the particular socio-cultural context.

Against this backdrop, it is not surprising that the majorities of the Haya are still using indigenous knowledge and related practices in adapting to climate change. The study concludes that efforts to adapt to climate change are faced with the challenge of integrating indigenous and western knowledge, without prioritizing one over the other.

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I would like to express my sincere appreciation to my family especially my beloved wife Joymertha Frank, and my children, Collins Rutashubanyuma and Hellen Atugonza whose love, understanding, unfailing encouragement, tireless support and prayers have motivated

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## *Dedication*

To my parents: Dad "Theodory Nshekela Bajunanaki (1938-2000)

Mom "Hellen Kokwijuka Rwezaula (1954-1991),

No single day that can pass without thinking of you
Usually, I think of the past and feel happy and sad
You both worked hard to make sure I grow in a happy family
I love you and I miss you.
And until we meet again,
May your souls rest in peace amen.

To my grandmother, my hero, Theresa Kokugonza Rwezaula, for all the support and love throughout my life, I thank you for grooming my life particularly being obedient to everyone. Also to my family particularly my beloved wife Joymertha Frank, my little kids, Collins and Hellen for the love, encouragement and your prayers that kept me motivated throughout this process.

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**List of Abbreviations**

| | |
|---|---|
| AGRA | Alliance for a Green Revolution in Africa |
| AIACC | Assessment of Impacts and Adaptations to Climate Change |
| APF | Adaptation Policy Framework |
| AR | Assessment Report |
| ASDP | Agriculture Sector Development Programme |
| BC | Before Christ |
| COP | Conference of Parties |
| DAO | District Agriculture Officer |
| DASIP | District Agricultural Sector Investment Project |
| DAS | District Administrative Secretary |
| DC | District Commissioner |
| DDT | Dichlorodiphenyltrichloroethane |
| DMO | District Medical Officer |
| FAO | Food and Agriculture Organization |
| FDI | Foreign Direct Investment |
| GDP | Gross Domestic Products |
| GEF | Global Environmental Fund |
| IMF | International Monetary Fund |
| IPCC | Intergovernmental Panel on Climate Change |
| KCU | Kagera Cooperative Union |
| KSHDER | Kagera Small Holder Dairy Extension Project |
| MAPEC | Missenyi AIDS and Poverty Eradication Crusade |
| MAYAWA | Maendeleo ya Wakulima |
| MDGs | Millennium Development Goals |
| MKUKUTA | Mkakati wa Kukuza Uchumi na Kupunguza Umaskini Tanzania |
| MMR | Mixed Method Research |
| NAPA | National Adaptation Programme of Action |

| | |
|---|---|
| NAP | National Agriculture Policy |
| NGOs | Non-Governmental Organizations |
| NSGR | National Strategy for Growth and Reduction of Poverty |
| PhD | Doctor of Philosophy Degree |
| PRA | Participatory Rural Appraisal |
| RRA | Rapid Rural Appraisal |
| SLT | Situated Learning Theory |
| SSA | Sub-Saharan Africa |
| UNFCCC | United Nations Framework Convention on Climate Change |
| UN | United Nations |
| UNDP | United Nations Development Programme |
| UNDRIP | United Nations Declaration on the Rights of Indigenous People |
| UNEP | United Nations Environmental Programme |
| UNICEF | United Nations Children's Fund |
| VEO | Village Executive Officer |
| WEO | Ward Executive Officer |
| WHO | World Health Organization |
| WMO | World Meteorological Organization |

# Chapter One

# Introduction

## 1.1 Overall aims of the thesis

The central objective of this thesis is to investigate the extent to which local communities experience and adapt to vulnerability and climate change impacts using indigenous knowledge in the Ngono River Basin, Tanzania. This objective is achieved using four specific objectives, which are; investigating the way local communities in the Ngono River Basin are confronted with different on-going climatic and non-climatic changes; assessing local perceptions of climate change in order to understand the way local communities make sense and put significances in what they observe; identifying, documenting and undertaking critical analysis of indigenous knowledge and adaptation practices to climate change used by the Haya people[1] to withstand climate change impacts in different livelihood activities; and investigating the relevance and challenges of applying indigenous knowledge in the face of climate change.

## 1.2 Background of the study

Global climate records indicate that there were various climate changes during the 20$^{th}$ century including: temperature increases, shifting rainfall patterns, a rise in the sea level and the reduction of snow and ice. All these changes had a drastic impact on global ecosystems. This indicates that global climate change is increasingly becoming one of the pressing global issues of the 21$^{st}$ century. However, climate change associated with the cumulative level of carbon dioxide is not expected to affect developed and developing countries evenly. Poor rural communities from developing countries will be seriously affected due to their reliance on climate sensitive activities for their livelihoods (Yanda and Mubaya, 2011, p.vii). Although the decisions to mitigate greenhouse gas emissions are vital in evading the worst effects of climate change, adaptation measures must also be into any climate change response. In other words, some of the crucial mitigation measures executed by different countries all over the world may be unable to offset the enduring effects of global warming in the future (IPCC, 2007). It is on this basis that adaptation now has been put on top of the

[1] The Haya people are amongst the largest ethnic and linguistic group in Tanzania inhabited in the Northern Western Corner of Tanzania in Kagera Region. They form the dominant tribe within region and occupy large parts of the Muleba District, Missenyi District, Bukoba Rural District and Bukoba Municipal.

development agenda by policy makers and scientists as a necessary complement to mitigation (Warrick, 2011, p.1).

Most developing countries are identified as being vulnerable to climate change. Particularly some countries in sub-Saharan Africa (SSA) are amongst the most vulnerable, because of their high exposure and low adaptive capacity to climate change risks (Niang et al. 2014, p.1205). It has been reported that a temperature increase of 0.7 °C had been reached across a large part of Africa during the 20$^{th}$ century. While warming trends appear to be uniform over the African continent, climatic changes are not always the same. This provides the basis for undertaking more research activities, which attempt to capture trends in climate change throughout the African continent in order to inform policies that focus on addressing climate change related problems (Yanda and Mubaya, 2011). Climate change adaptation currently involves collective action in which developed and developing countries have been assigned different responsibilities for addressing climate change issues (Article 1) under the United Nations Framework Convention on Climate Change (UNFCCC) (UN, 1992). In particular, developed countries are required to support developing nations to meet the costs of adaptation measures (Article 4(4)) (UN, 1992). Irrespective of the increasing profile of adaptation measures in developing countries due to an increase of their funding, the challenge remains to understand how these on-going adaptation measures can be implemented in a way that reflects the needs of rural poor communities in these countries (Warrick, 2011, p.2).

In the field of climate change, the introduction of adaptation concepts is still a relatively new phenomenon because of the disproportionate amount of attention mitigation policies have received from politicians and academics over the past two decades. While developed from the UNFCCC process around early 1990s, the adaptation concepts have become more prominent in the lexicon of international climate change negotiations since the *Marrakech Accords* in 2001 (Eguavoen et al. 2015, p.1184). The decision not to embrace adaptation as a feasible policy option was based on the fear that pursuing adaptation measures would paralyze the political will within the international community to reduce greenhouse gases (Pielke, 1998; Schipper, 2009; Burton, 2009). The central argument that helped to turn the tide in favour of of adaptation was the scientific report of the Intergovernmental Panel for Climate Change (IPCC)[2], which observed that climate change was already happening globally. Therefore, it

[2] The Intergovernmental Panel on Climate Change (IPCC) is an important international body dealing with the assessment of climate change. The establishment of this international body was made by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in 1988 to

was shown that adaptation to climate change in developing countries, particularly SSA countries is not optional but is in fact, required because populations in those areas are already suffering negative impacts from it (Boko et al. 2007, p.452).

This thesis deals with an approach to adaptation that assumes that adaptation is already a dominant concept in global development (Ayers and Dodman, 2010, p.162). Since its inception in developing countries, adaptation has become one of the most important pillars for development intervention. Adaptation concepts have mobilized a collection of actors, funds, as well as institutional reforms, to the extent that it has been placed on top of major development agendas particularly in developing countries (Tanner and Allouche, 2011, p.1). Existing assumptions predict that the African continent will face severe impacts caused by climate change and that local communities must adapt rapidly in order to cope with these impacts. From this perspective, the adaptation paradigm is taken as a "new prophecy" for developing countries, strongly imbuing them with the notion that adaptation to climate change is a necessary condition for survival. Within the present research agenda a propensity can be observed that "envisions adaptation to climate change as a highly technical response to biophysical conditions, for which a toolbox of programmatic and 'cookie-cutter' solutions is needed that enables people to adapt in thoroughly planned and predictive ways to future climates" (de Wit, 2015, p.3).

The above assumptions that underpin such an approach are evidence of the existing dominance and influence of the natural science fields in climate change research (de Wit, 2015). Hulme (2011b) criticizes this dominance, arguing that that "new climate reductionism is driven by the hegemony exercised by the predictive natural sciences over contingent, imaginative and humanistic accounts of social life and visions of the future". This is a hegemony which gives asymmetrical power in political and social discourse to the model based descriptions of future climate change (Hulme 2011b, p.1). This existing technocratic approach to climate change dominates the discourse of the adaptation approach in global politics and social sciences at the expense of more contingent, explanatory and inventive accounts of social life (Hulme 2010, 2011a; Strauss and Orlove, 2003; Rudiak-Gould, 2011). Taking into account the need and relevance of developing prognostic instruments and

provide the world with a clear scientific view on the present condition regarding the knowledge of climate change and its potential environmental and socio-economic impacts. The UN General Assembly in the same year endorsed the action by UNEP and WMO together establishing the IPCC (https://www.ipcc.ch/organization/organization.shtml).

forecasting models, it will be argued that if one does not consider local cultures when looking at the implementation of adaptation measures, it will result in : (a) a failure to understand the socio-cultural embedded practices, in which adaptation is locally valued and approved; (b) political struggles that are caused by the introduction of the concept of adaptation to the climate change paradigm (de Wit, 2015, p.4).

Adaptation in the context of development has changed significantly since the beginning of the new millennium. Existing public debate is dominated by planned adaptation as a reaction to climate risks. Additionally, adaptation to climate change and variability as a research topic has gained popularity in the natural and social science disciplines (Eguavoen et al. 2015, p.1184). The language of the public discourse spoken revolves around the concept of 'global warming' and regularly uses several buzzwords such as 'catastrophe', 'terror', 'danger', 'extinction' and 'collapse' in the both the global North and South (Hulme, 2008, p.5). Different international institutions and development agencies, as well as civil society organizations and the private sector have taken the lead in fighting global warming. This is apparent in Africa, where there has been an increase in the engagement of local and national governments, NGOs, media, churches, religious and traditional leaders, who shape 'climate change riskscapes' (Eguavoen et al. 2015). Despite increasing engagement of local and international governments, NGOs and alike in climate change adaptation initiatives, the integration of local communities, particularly their indigenous knowledge is not sufficient.

In Africa as well as in other parts of the developing world, local communities already practice different forms of adaptation practices in response to climate change in their local area. These practices rely heavily on indigenous knowledge, which plays great role in climate change adaptation at the local level. The term 'indigenous knowledge' refers to the unique, local, traditional knowledge existing within and developed around the specific conditions of a community in a particular geographic area. This knowledge system is accumulated from generations of experiences, which involve careful observations as well as trial and error with new knowledge being continuously added (Grenier 1998, p.1). While indigenous knowledge is often employed throughout the course of normal subsistence activities, it can also take the form of acute responses, applied only when facing critical climatic threats (Stott and Kettleborough, 2002). Despite the fact that the question of what exactly constitutes a successful adaptation to climate change at local level remains unanswered, it is a purpose of this study to delve further into how local communities living in the Ngono River Basin adapt to climate change using their indigenous knowledge.

Throughout sub-Saharan Africa, there is evidence that different rural and indigenous communities are actively establishing visible initiatives to adapt to climate change (see Egeru, 2012; Ajani et al. 2013). One significant step implemented by these communities in reducing vulnerability to climatic risks is the development of an early warning system for the prediction of a climate related events (Ajibade and Shokemi, 2003). It has been established that there is indigenous knowledge grounded in weather and climate forecasting, which has helped the local communities to adapt to climate change. However, many studies on indigenous climate knowledge in various parts of SSA countries have revealed the wealth of knowledge that farmers possess. Farmers have developed different knowledge systems for adapting to climate change and these systems have been very helpful to the farmers as they are able to manage vulnerability to climate change to a great extent (Mengistu, 2011, p.142).

Although different scholars laud the use of indigenous knowledge in different development interventions including climate change adaptation (Egeru 2012; Ajani et al. 2013), this knowledge is criticized for being location specific and therefore inapplicable to different societies. Thus, indigenous knowledge can only be applicable to a society, in which it originates. Leach and Mearns (1996, p.32) went further when they suggested that indigenous knowledge is repeatedly charged with being "methodologically weak or unproven… populist or politically naïve; and that it generates findings that are too complicated to be of practical use to policy makers". These pressing problems pose major challenges for the advocates of indigenous knowledge arguing for its use in development intervention (Briggs, 2005). Such doubts over indigenous knowledge need a thorough investigation. This study will be an attempt to address this problem within the context of the communities living in the Ngono River Basin.

However, while the dialogue between indigenous knowledge and western knowledge seems interesting, tensions remain. Chokor and Odemerho (1994, p.153) provided a remarkable suggestion that "once official views and community values are integrated, conflict and rivalry associated with traditional and modern land conservation measures in tropical Africa will be considerably reduced". Such a condition, however, appears to be still some way off. Homann and Rischkowsky (2001), for example argue that the difficulty in integrating indigenous and western knowledge systems is that the latter searches for knowledge of global significance, which is not context specific, whilst the former is socially produced and embedded in a specific cultural and environmental milieu. What is interesting is that western knowledge is

sometimes considered to be in some way objective, disconnected and isolated from particular socio-cultural, political and physical contexts. In fact, like indigenous knowledge, western knowledge is socially constructed, and it is thus ironic that the charge is often made that indigenous knowledge is too local and culturally specific to be universal and moveable. In maintaining the status of western knowledge, its doubts are rarely disclosed, despite 50 years of development in African and other places have not resulted in changing community lives (Krugly-Smolska, 1994, p.333).

### 1.3 Indigenous knowledge and climate change adaptation

Local communities seek to adapt to new challenges such as climate change, they do not seek solutions aimed at responding to climate change alone, rather for holistic solutions to enhance their resilience to a wide range of risks and shocks from different sources, some of which may have equal, or greater, negative impacts to their communities (Mistry and Berardi, 2016, p.1274). Adaptation practices to climate change by the local communities are grounded on their indigenous knowledge. This knowledge is embedded in the socio-cultural context of the community. Local communities use this knowledge to inform their decisions when responding to climate change impacts. Therefore, the Integration of indigenous knowledge with new technologies to deal with climate change may assist communities in effectively responding to impending climate changes (Ishaya and Abaje, 2008). This is because indigenous knowledge forms the basis for local level decision making in many rural communities and has value not only for the culture, in which it develops, but also for planners and scientists struggling to improve conditions in those rural areas (Ajani *et al*, 2013, p.24). In recent years there has been a mounting interest in participatory and community based adaptation approaches, particularly in developing countries by trying to integrate local communities in development and adaptation endeavours respectively. Both approaches involve shifting the rhetoric of rural development practices, whereby local communities are involved in different development activities. These shifts include the current familiar reversal from ‘top-down to bottom-up’, from ‘blueprint to learning process’, and from ‘centralized standardization to local diversity’ (Chambers, 1994, p.1). These approaches focus on ‘bottom-up’ and are aimed at addressing the weakness of conventional ‘top-down’ approaches to development and adaptation (Warrick, 2011, p.2). In the meantime, it is difficult to implement local level climate change adaptation measures while excluding the socio-cultural context in which indigenous knowledge evolved. In fact, local communities constitute an important part of local ecosystems and play a great role in enhancing their

resilience. These communities have been observing and sharing the experiences of their environments as well as interpreting local meteorological phenomena, in order to guide their seasonal and inter-annual activities for centuries (Usher, 2000).

Accordingly, viewing adaptation to climate change with a 'bottom-up' lens will eventually accommodate indigenous knowledge and practices, which have been traditionally side-lined and marginalized by conventional science. For many years, local communities in the Ngono River basin, who are smallholder farmers and livestock keepers, have accumulated detailed knowledge regarding the functioning of their immediate environment, including observations and intuitions on a wide array of issues such as temperature changes and rains regimes. Unfortunately, this valuable knowledge is yet untapped. This thesis uses a 'vulnerability-led' approach to adaptation, which offers a useful way forward to learn how local communities cope and adapt to climate change related stresses. To do this, this study aims to scrutinize indigenous knowledge and practices that can complement conventional 'impact-led' approaches to climate change adaptation. From this backdrop, I will formulate and state the research problem in its wider context in order to understand different adaptation practices in the face of different on-going changes, specifically climate related events among the communities living in the Ngono River Basin.

### 1.4 Statement for research problem

Currently, the Tanzanian government is implementing the National Climate Change Strategy, which was officially launched in 2012, alongside the National Adaptation Programme of Action (NAPA), which was officially launched 2007. These strategies present the country with an opportunity to undertake both climate change adaptation and greenhouse gases (GHGs) reduction globally in the context of sustainable development. Much of these efforts seem to put more emphasis on the conventional approach to adaptation to climate change (see Smit and Pilifosova, 2003). Despite increasing attention on adaptation to climate change in Tanzania, these efforts have not sufficiently involved local communities or their indigenous knowledge. The assumption is that local communities practice different types of adaptation strategies using indigenous knowledge, which have been derived from their daily experiences of living with nature. Such knowledge is important for the local communities as it is socially constructed, and it is embedded within their socio-cultural context.

The indigenous knowledge of the Haya people encompasses what people have known and done for generations. A large part of this knowledge includes daily practices that have

evolved through generations of trial and error, and have more or less proved flexible enough to adapt to climate change. Currently, the indigenous knowledge of the Haya is in danger of being lost if it is not well documented as community elders, who are the main custodians of this knowledge, are swiftly decreasing within the community. Of critical concern is the growing perception among the younger generation of indigenous knowledge as outdated and inefficient, with little potential for incorporation into current development policies. Additionally, recurrent environmental changes in the area have caused some of the local people within the community to perceive indigenous knowledge as inappropriate to respond effectively to climate related risks in the area. As a result, some of the local communities have started to put more faith into western knowledge to adapt to climate change. The challenge is that western knowledge includes promises short term gains or solutions to problems but does not often provide mechanisms of sustaining them. In addition, western knowledge can be too expensive for local communities to afford, and more importantly, this knowledge is not embedded in their socio-cultural context, which renders it inapplicable in many instances. In this context, indigenous knowledge remains the best local adaptation strategy among the Haya. If existing strategies on climate change adaptation will not integrate indigenous knowledge, then government initiatives on poverty eradication are likely to fail. Traditionally, these strategies use the conventional approach which minimizes the role of indigenous knowledge. The specific drive of this study is to create an understanding of different climate change adaptation practices, particularly indigenous knowledge-based practices used by the Haya to adapt to climate change. The overarching research question of this thesis is: **how do local communities experience and adapt to vulnerability and climate change impacts using indigenous knowledge in the Ngono River Basin, Tanzania**.

### 1.5 Relevance of the study

As they depend almost entirely on natural resources, the livelihoods of local communities in this study area are endemically exposed to numerous uncertainties. For instance, the foliage cover of grazing land in African drylands relies on unpredictable variations in precipitation and other climatic factors (Scoones, 1992). Accordingly, local communities especially the farmers and livestock keepers normally respond to these uncertainties by employing diverse livelihood mechanisms. It is therefore important to explore how the Haya deal with crises (namely drought, decreased rainfalls, shifting of rain patterns and recurrent strong winds) within their local environment. The findings from this study should enable us to identify

important variables in the patterns of indigenous knowledge adaptation practices. These variables can be buttressed, modified, or improved in order to develop long-term climate change adaptation mechanisms among poor rural communities. The planning of a low-cost and high return approach to climate change adaptation requires that the approach be built on the 'vulnerability-led' patterns of local adaptations. Thus, this study will help to assess the suitability of the existing conventional approach in both districts (Muleba and Missenyi) and if sufficient effort has been made to identify alternative approaches to climate change adaptation.

More specifically, the Tanzanian government is currently implementing phase two of the National Strategy for Growth and Reduction of Poverty (NSGR in Swahili *MKUKUTA*), which the fourth goal under cluster two focusing at, among other things, ensuring environmental sustainability, climate change adaptation as well as mitigation. The findings from this study therefore, stand to provide vital policy recommendations that will contribute to the implementation and attainment of this goal. However, this is a small scale study and the findings will complement and act as a reference point for other similar studies to be conducted in other parts of the country or the world. Since indigenous knowledge has been marginalized in the process of development planning and modernization; therefore, revealing the opportunities and challenges indigenous knowledge has in the fields of climate change adaptation, can help integrate this knowledge into connected programs and projects.

### 1.6 The organization of this thesis

This thesis is organized into nine chapters. The introductory chapter presents the research aim and its background, states the research problem as well as the key research question, and explains the justification of this study. Chapter Two provides the conceptual and theoretical basis of this thesis by explaining the concepts of indigenous knowledge and adaptation to climate change as they are employed in the climate change field. Situated Learning Theory (SLT) is also explained in this chapter to illustrate the process of learning and knowing indigenous knowledge in the socio-cultural context of a certain community. This chapter will also outline the rise of the vulnerability framework in climate change adaptation, and link the vulnerability-led approach with the broader context of climate change adaptation at local levels, which gives local communities more power in making decisions regarding adaptation. In Chapter Three, I provide an overview of the methodology used in this research. This chapter outlines the step by step progression of my research from the data collection exercise to the analysis of the data. It goes on to explain the different methods I developed to address

my research objectives, and explains the selection of the study sites in the Ngono River Basin. Additionally, this chapter describes in detail how the triangulation technique was applied in data collection and analysis. Building on that, Chapter Four presents the regional setting of the study area. In this chapter, I explain the historical context of the Haya people who are the dominant ethnic group in the study area. This chapter also outlines a general description of the study area, and lastly presents the environmental profile of the surveyed villages. Chapter five marks the onset of the presentation, analysis and discussion of the empirical findings. It presents different on-going changes, which contribute to community vulnerability and the extent to which these changes have undermined the adaptive capacities of the local communities in responding to climate change risks.

This leads into Chapters Six and Seven where I present the way in which local communities make sense of what they observe, and what specifically the local communities choose to put significance and meaning on in relation to what they observe. In Chapter Six, I present local knowledge about the perceptions of the changing climate. In Chapter Seven, I present various daily practices undertaken by the local communities to adapt to climate change impacts. Chapter Eight focuses on the relevance, hegemony and challenges of indigenous knowledge in climate change adaptation at the local level. Chapter Nine then concludes by directly answering the overarching research question posed as the research aim.

# Chapter Two

## Indigenous Knowledge and Adaptation to Climate Change: Conceptual and Theoretical Reflections

This chapter is organized into nine sections. The first section is a critical discussion of the term 'indigenous knowledge'. The second section discusses how the term indigenous knowledge is used in development discourse. The third section focuses on the learning and understanding processes of indigenous knowledge. The fourth section introduces the concept of Situated Learning Theory (SLT) which provides a vital framework for the exploration of knowledge acquisition processes within communities. Section five introduces the concept of adaptation and specifically, climate change adaptation. The sixth and seventh sections focus on the theoretical debate surrounding the rise of the vulnerability approach in adaptation research and its different interpretations in climate change research. Section eight establishes the conceptual framework of this study. Finally, section nine presents a summary of the guiding research questions.

### 2.1 The myth of indigenous knowledge

This section analyses the concept of 'indigenous knowledge', and how this concept functions theoretically as well as empirically. Indigenous knowledge, as conceptualized in this thesis, consists of everyday practices, learning and experiences of local communities with regard to their surrounding environment. The first part of this section interrogates what should be considered as 'indigenous' to any given society. It is difficult to find a reasonable way to understand how people of various backgrounds develop, practice and sustain their knowledge. This section, therefore, cautions us not to take the concept of indigenous knowledge for granted by generalizing it as something homogenous or inherent only to particular groups. Rather, what is emphasized is that there is a hybridization of knowledge that takes place due to external influences and on-going socio-cultural transformations. The last part of this section addresses the issue of separating indigenous knowledge from western knowledge. Such a differentiation originates from a western world-view that brought with in, among other things, a dichotomy between developed and developing societies. On the basis of the existing debate concerning the content, usage and impact of indigenous knowledge on the development, this section therefore, raises the following questions: what is considered

indigenous? What constitutes indigenous knowledge? Who is responsible for producing indigenous knowledge and for what purpose?

Current debates in the literature and practice are mostly centered on the question of what is considered 'indigenous' (see also Hughes, 2003; Niezen, 2003). The major concern is based on the conceptual choices and the terms used by different scholars. Lonzano argued that the term 'indigenous' should be considered politically charged and that its definition varies significantly from one context to another. In relation to SSA, where many interventions in the name of development exist, the concept can be difficult to define clearly (Lonzano, 2013, p.4). As observed by Pelican (2009) in her study on the legal status of Mbororo pastoralists in Cameroon:

> Whereas in North, Central, and South America indigenous activism has a long history and the status of first peoples is generally uncontested, the situation in Africa is different. Here defining which groups may count as indigenous is much more problematic and controversial, as there are long and on-going histories of migration, assimilation, and conquest. Furthermore, as Kopytoff (1987) has convincingly demonstrated, African societies tend to reproduce themselves at their internal frontiers, thus continuously creating and re-creating a dichotomy between original inhabitants and latecomers along which political prerogatives are negotiated. This recurrent process does not allow for a permanent and clear-cut distinction of first nations versus dominant societies, as implied by the universal notion of 'indigenous people' (p.56).

The above quotation buttresses the fact that African societies have always been mobile. This is evident in many parts of SSA, including the study area, where the Haya people are reported to have migrated from the southern part of Uganda (Effiong, 2009). They eventually settled in the Kagera Region, located at the north-western corner of Tanzania (cf.4.1). Thus, to any given society, it is often difficult to distinguish locals from strangers, given the fact that people always migrate from one place to another, sometimes settling temporarily and sometimes taking up permanent residence. However, the term 'indigenous' has been used by marginalized groups all over the world to define and justify their movements (Hodgson, 2002, p.1032). In turn, during the colonial era, particularly in Africa, local residents were often described using denigrating terms such as 'tribal,' 'primitive,' 'savage' or 'wild', and were seen as worthy only of domination, providing a justification for colonial rule (Sundra, 2000, p.81). The marginalization of indigenous people has greatly put their knowledge outside the realm of science and technology as it was seen as something that cannot bring tangible results like western knowledge could (Luthfa, 2006, p.14).

However, marginalization is not synonymous with 'indigenous'. There are diverse groups of people around the globe who have been marginalized for many years, but are not recognized for indigenous rights or labeled as indigenous people (Niezen 2003; Dei *et al,* 2000; Semali and Kincheloe, 1999). One can use the example of the beggar and homeless communities, such groups are not entitled to indigenous rights despite being marginalized and vulnerable members of society. This is due to the fact that many of the advocates for indigenous peoples put a disproportionate amount of attention on those living in the countryside and neglect others. As accentuated by Li (2000, p.151) "one of the risks that stems from the attention given to indigenous people is that some sites and situations in the country side are privileged while others are overlooked, thus unnecessarily limiting the field within which coalitions could be formed and local agendas identified and supported".

Since various scholars and development interventions have tried to define what is considered 'indigenous', none of them have successfully provided a definition that can satisfy the interests of the diverse body of indigenous groups worldwide. Thus, the question of 'who is indigenous?' perhaps might best be answered by indigenous communities themselves. To attest this contention, 'self-identification' policies for indigenous people in recent years have increasingly become acknowledged in international legal practice starting in 1977, when the second general meeting of the World Council of Indigenous People (WCIP) approved a resolution stating that "only indigenous people could define indigenous people" (Corntassel, 2003, p.75). In a similar vein, during the drafting of the United Nations Declaration on the Rights of Indigenous People, the representatives of indigenous populations emphasized the need for indigenous people to have the right to define themselves. This would generate circular definitions of 'indigenous' whereby people who claimed to be indigenous could define themselves based on criterion on that they themselves defined (Imai and Buttery, 2013). Giving indigenous people the rights to define themselves may spawn more challenges for creating an appropriate definition of indigenous that will work for all societies. These definitions may be biased and exclude other members of a society. For example, if you give the Rwandese Tutsi people the right to define who should be considered an indigenous Rwandese, there is a danger that this definition may recognize only the Tutsi as indigenous Rwandese and neglect the Rwandese Hutu.

Another crucial issue is centred on the conceptual relationship between indigenous people and indigenous knowledge. The focus here is centred on what constitute indigenous knowledge? Who produces indigenous knowledge and for what purpose? Conventionally, indigenous knowledge has been represented as something opposed to western knowledge (Nygren, 1999, p.267). It subsumes a cumulative body of beliefs, practices, and information evolving by adaptive processes and passed through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment (Berkes et al. 2000). Indigenous knowledge is acknowledged as playing a fundamental role in the management of local resources, in providing locally valid models for sustainable living, and in the husbanding of the world's biodiversity. This knowledge, which is believed to be owned by indigenous people is argued by some to be complementary to, equivalent with, and applicable to western knowledge (Turner et al. 2000, p.1275). Based on this recognition, it was proposed in the Brundtland Report, *Our Common Future* that, "….the larger society…..could learn a great deal from their (indigenous peoples') traditional skills in sustainably managing very complex ecological systems" (World Commission on Environment and Development 1987, p.115). Unfortunately, existing conventional perspectives envisage indigenous knowledge as internal to a particular community or household and unaffected by the outside world. Although much of the knowledge held by local people may indeed be indigenous in the sense that it has been handed down through the generations within a community or household, much of it is also comes from outside. It is difficult to find knowledge being utilized by local communities in the present era that has no outside influence whatsoever. In the study area for example, local people usually adopt outside knowledge as part of a broader environmental knowledge list, but only if it makes environmental, socio-cultural and economic sense to do so (cf. 7.2).

Most anthropologists have been happy to emphasize the 'indigenous point of view' and to view local people as the predominant producers of indigenous knowledge concerning natural resource management, medical cures and cosmological theories and medical cures (Moore (1996, p.2-3). This is deliberately done to defend their theoretical position that local people are the producer of indigenous knowledge; however, less attention has been paid to the hybrid character of such knowledge. Indeed, indigenous knowledge entails various forms of knowledge, which are often assessed, re-worked and used in the interests of household activities (Briggs et al. 2007). Thus, community knowledge on the environment is not something that only emanates internally, but is rather, influenced by external influences such

as extension staff (local agricultural experts), non-governmental organizations (NGOs), and farmers from other communities. Hence, the indigenous knowledge held by a certain community is usually updated and mediated due to external influences. This clearly challenges the idea of a binary divide between indigenous knowledge and western knowledge, which pits indigenous knowledge against western knowledge (Briggs et al. 2007, p.247). Thus, outside knowledge does not negate indigenous knowledge, but rather, local people evaluate outside knowledge to see if it is appropriate to their socio-cultural, economic and environmental setting. This fact is reflected in the empirical part of this thesis, in that Haya usually apply different forms of knowledge, which are useful and affordable to them when adapting to climate change (cf.7.2).

However, the very notion of 'indigenous knowledge' is a western created concept, which introduces a dichotomy of traditional *versus* modern within the distinction of indigenous *versus* western knowledge. It is ethnocentric to relegate certain knowledge as 'indigenous' as opposed to 'scientific' based on the difference in the origins of the knowledge. Western scholars created the dualism between 'developed' and 'underdeveloped' societies, and suggested that underdeveloped societies had to follow the example of developed societies in order to become 'developed' (Luthfa, 2006, p.3). It is not reasonable for any knowledge to be fixed as 'indigenous' or 'western', and thus, an attempt to create a dualism between indigenous and western knowledge does not make sense. Existing evidence has demonstrated that due to contact, variation, transformation, exchange, communication, and learning between different cultures for the last several centuries, it is problematic to adhere to a view that indigenous and western types of knowledge are untouched by each other (Agrawal, 1995a, p. 14). Thus, the debate over the dichotomization of indigenous knowledge and western knowledge can be considered artificial (Ehlert, 2007). As argued by sociologists Berger and Luckman (1980 cited in Ehlert, 2007, p.8), "local knowledge is not exclusively to be associated with Western societies. Instead, both forms of local knowledge and global constitute every society in general and therefore are not to be misunderstood as bipolar reference systems".

From the above discussion, it can be seen that indigenous knowledge is a complex concept. There should be a comprehensive, dynamic, and flexible approach relevant for precisely understanding the concept of indigenous knowledge in contemporary societies. This is due to the fact that historical, cultural, political, and social transformations underway today,

particularly in the global south have resulted in the cultural hybridization of indigenous peoples and their knowledge. In any given community or household there are varieties of knowledge which may assist local people to adapt to any environmental changes particularly climate change. This knowledge originates internally and externally. It is therefore important, to recognize different forms of knowledge within communities and households, rather than to rely on one kind of knowledge, be it 'western' or indigenous'. If a certain piece of knowledge is useful to a local community, and it is appropriate for their environmental, economic and socio-cultural context, then it will be worth using, irrespective of whether it is drawn from indigenous knowledge or western knowledge (see Briggs et al. 2007). As previously conceptualized therefore, the term 'indigenous knowledge' is used in this thesis to represent everyday practices, experiences, learning and teaching exercised by the local communities inhabiting the Ngono River Basin to adapt to different on-going changes, particularly climate change impacts. It is however important to emphasize that, this thesis does not treat the concept of 'indigenous' as something rigid or static that is unable to incorporate innovations. Rather, it is a flexible concept, which can easily integrate skills and insights from external knowledge as well as from daily practices and experiments (cf. 8.1).

### 2.2 Indigenous knowledge and development

This section presents a critical reading of indigenous knowledge and how it is depicted as an important resource, which can contribute to the increased effectiveness, efficiency, and sustainability of the development process. Many scholars have recognized the benefits that indigenous knowledge can offer to development among the poor rural communities in many parts of the world (see Brokensha et al. 1980; Briggs and Sharp, 2004; Briggs, 2005; Bryan, 2005; Briggs, 2013, 2014). This section starts by examining the benefits of indigenous knowledge in development. The section draws on post-development theory to explain how indigenous knowledge can provide a possible alternative for development among the global rural poor population. It is argued that development cannot be attained through a top-down approach that does not take serious consideration of people, culture, and knowledge in a local context. Finally, the section concludes by highlighting the problems and tensions that have caused indigenous knowledge to fall short of its expected usefulness.

Since the end of the Second World War the development agenda has lumbered through different stages, from its focus on economic growth, to growth with equity, to basic needs, to participatory development, to sustainable development (Agrawal, 1995a). Over recent decades, indigenous knowledge has emerged as one of the popular phrases in the rhetoric of

development all over the world. Interest in indigenous knowledge gained popularity during the 1980s, mainly in response to dissatisfaction with modernisation as a means of improving the standard of living among the rural poor population in the global south. The failure of modernisation to eradicate poverty in the global south was a major factor in the rise of indigenous knowledge as a concept in development. It was assumed by the proponents of modernisation that, global south could be lifted out of poverty by the transfer of technical knowledge from Europe and North America. By the 1980s, however, it became clear that this approach was not having the expected success, particularly in Africa (Briggs, 2013, p.127). Consequently, alternatives were sought to promote local-level development while undertaking anti-development movement (Dada, 2016). This was the major reason for the rise of the post-development perspective, which takes a critical look at the practice and theory of development.

Post-development theorists argue that development has failed due to its overbearing tendencies, as the entire concept and practice of development has become too steeped in an ideology of Western supremacy, and because it has moved development out of the hands of local communities (Dada, 2016, p.75). One among the renowned post-development scholars, Arturo Escobar captured this mounting spirit among the post-development scholars when he wrote; "the remaking of development must start by examining local constructions, to the extent that they are the life and history of the people, that is, the conditions of and for change" (Escobar, 1995, p.98). This highlights the relevance of the histories, geographies and socio-cultural constructions of local communities in understanding community level development, and importantly, to acknowledge indigenous knowledge as a valid body of knowledge (Briggs, 2013, p.127). Therefore, the core of post-development is centred on an examining and/or challenging of power dynamics (Johnson, 2014).

Post-development scholars were extremely dissatisfied with standard development rhetoric and practice, and were disillusioned with alternative development (Pieterse, 2000, p.175). Development at the local level should not be approached through a top-down, trusteeship model, but through a bottom-up approach that take into consideration local contexts and the needs of local people. Using the top-down approach in development discourse and practice may lead to the cultural homogenisation of the world, a tendency that would favour the developed nations of the West. It is therefore emphasized that development is a cultural process and should include the people that are the focus of development. In so doing,

indigenous knowledge, daily experiences and practices of the people have to be taken into account during the development process (Dada, 2016). Indigenous knowledge is appropriate to all grass-roots actors, as it is the knowledge which the local communities themselves own and is subject to little extraneous influence. It can thus be used for measures that improve the communities on the terms of the local people instead of the terms of others (Marsden, 1994).

Different scholars have emphasized that indigenous knowledge is the latest and best strategy in the age old battle against poverty, hunger, and underdevelopment (Agrawal 1995a; Ajibade and Shokemi, 2003; Akullo et al. 2007; Ayana et al. 2012; Ajani et al. 2013). Since indigenous knowledge has allowed its owners to exist in harmony with their environment, using this knowledge sustainably is perceived as crucial in discussions of sustainable resource use and balanced development (Agrawal 1995a, p.413; Briggs, 2013). This orientation stands in stark contrast to the views of earlier theorists, who perceived indigenous knowledge and institutions as inferior, and obstacles to development. Current schools of thought concerning indigenous knowledge, however, recognize that disregarding the knowledge of the poor and marginalized populations may be naïve (Agrawal, 1995b). Indigenous knowledge is an important and appropriate alternative approach which can empower local communities to develop themselves. Thus, the relevance of indigenous knowledge in development is, consequently welcomed, as it embodies "a shift from the preoccupation with the centralized, technically oriented solutions of the past decades that failed to alter life prospects for a majority of the peasants and small farmers of the world" (Agrawal 1995a, p.414). In many instances, different environmental and resource management approaches have been formulated with the exclusion of local cultural factors and expertise on the issue, thereby resulting in the rejection of such initiatives by the local people leading to the failure of the project (Chaudhury, 1993). A lack of acceptance of indigenous knowledge, alongside a lack of participation, sense of ownership and responsibility among the local communities, eventually contributes to failure of many meaningful development interventions (Vorte, 2012).

In climate change research, indigenous knowledge has been steadily acknowledged for its value with respect to environmental issues, particularly climate attendant risks and weather forecasting (Green and Raygorodetsky, 2010, p.240). Most recent studies have incorporated the contribution of indigenous knowledge into works associated with climate and development as well (Orlove et al. 2010; Raygorodetsky, 2011; Egeru, 2012; Kirkland, 2012;

Ajani et al. 2013; Parsons et al. 2013). Importantly, the IPCC Fourth Assessment Report (2007) acknowledged the relevance of indigenous knowledge as the basis for developing adaptation and natural resources management practices to withstand environmental change. This was reiterated at the 32nd session of the IPCC[3] in 2010: "indigenous or traditional knowledge may prove useful for understanding the potential of certain adaptation strategies that are cost effective, participatory and sustainable" (Naanyu, 2013, p.15). Previous IPCC Assessments were unable to access this type of information as most indigenous knowledge either appears in grey literature outside the academic realm or remains in oral form, thus falling outside the scope of IPCC process (Naanyu, 2013). Recently, there has been increased attention given to the knowledge and capabilities embraced by small scale farmers in Third World nations as a profound basis for sustainable agriculture development. Previously only anthropologists examined the relevance of indigenous knowledge for development, however there has been an increased interest in this topic by research scientists and extension staff members from various fields. They realize that rural people in many developing countries have relevant knowledge regarding their resources and can effectively adapt to different changes overtime. Some of these research scientists have attempted to integrate indigenous knowledge in research and development, as a substitute approach to the western knowledge that is often unsuitable for the interests of the local community (Thrupp, 1998, p.13). Despite this, indigenous knowledge and alternative bottom-up approaches continue to be side-lined because of the supremacy of Western knowledge and the conventional top-down approach in research and development. A great deal of current development thinking still reflects the dominance of western science. Development remains a technical challenge and the voices of the poor rural communities are often drowned out (Briggs, 2013). In order to address this challenge, this thesis attempts to investigate and document indigenous knowledge used by the Haya people to adapt to climate change.

Despite the term 'indigenous knowledge' being widespread, it is problematic in many instances as many studies have shown that everyday knowledge in western societies is not different in principle from everyday knowledge in non-western societies. Furthermore, the words used in this field (indigenous knowledge, local knowledge, traditional knowledge etc.) cannot be easily seen as interchangeable technical terms, but must be understood in a political context (Antweiler, 1998; Chambers, 1983). Its inherent normative and political meaning

[3] Recently released IPCC report reveals that there are still on-going debates regarding local communities and the knowledge they hold.

implies a qualitative assessment that distinguishes between ‘good’ indigenous knowledge of ethnic minorities that should be protected, and ‘bad’ western knowledge that has been exported by western societies and applied to the ‘rest’ of the world that should be disregarded (Antweiler, 1995 as cited in Ehlert, 2007, p.7-8). However, it is often wrong to presume that the indigenous knowledge of a community is evenly practiced throughout a community or that it is feasible that every community member should be familiar with that knowledge (cf. 8.3.6). It is important to note that, the successful application of indigenous knowledge to any community depends on whether this knowledge is in specific to the social and cultural context of that particular community (Antweiler, 1998), and hence inapplicable beyond its local context.

Indigenous knowledge is restricted by the language, traditions, and values of the specific communities which tends toward conservation and isolation of that knowledge (Gerke and Hans-Dieter, 2006). That means indigenous knowledge seems to be location specific and hence not easily transferable to other communities, which do not share the same traditional and cultural values of the community where the knowledge originates. Most indigenous knowledge is not well documented for future generations. This knowledge is often transmitted orally from one generation to the next, which renders it difficult to preserve. This is due to the fact that traditionally, African education is been conducted orally. In the current situation where most of the custodians (elders) of this knowledge are decreasing too fast, particularly in SSA, indigenous knowledge is at risk of disappearing since few communities have a plan to compile this knowledge (Msuya, 2007). Therefore, integrating indigenous knowledge into development policies for the rural poor population may not bring fruitful returns in the near future because the population of elders is decreasing and hence the knowledge may be soon lost (cf. 8.3.2).

Indigenous knowledge is sometimes accepted uncritically due to naïve notions that whatever done by indigenous people is naturally in harmony with the environment. There is historical and contemporary evidence that indigenous peoples have also committed environmental degradation through over-hunting, over-grazing or over-cultivation of the land. Thus, it is misleading to think of indigenous knowledge as always being 'good’, ‘right’, or ‘sustainable’ (Tanyanyiwa and Chikwanha, 2011, p.140). However, indigenous knowledge can be easily affected by socio-economic transformation. Such transformation may force indigenous peoples to integrate with larger societies, consequently, their social structures, which underpin indigenous knowledge and practices, can easily break down (Grenier, 1998, p.8).

This may culminate to changes of indigenous beliefs, values, know-how, customs and practices, which ultimately lead into incomplete knowledge base (cf. 8.3.4).

However, post-development theorists who usually promote the autonomy of indigenous knowledge in the development process at local levels have been criticized for their narrow attitude towards actual, prevailing development. For example, Pieterse (2000) presents a homogenous and neo-populist outlook of development, which exaggerates indigenous knowledge and improperly critiques modern techno-scientific progress. In a related way, post-development theorists do not pay much attention on what might be considered the achievements of contemporary development such as the dramatic increases in life expectancy in recent years. Advocates of this theory usually respond that any such improvements are compensated by losses or sometimes ascend only with the maintenance of a lopsided international power structure. Whether the issue of losses and gains can be empirically resolved is arguable, but what is undoubted is that gains are realizable, as they have always been in the asymmetrically developing capitalist system (Storey, 2000).

### 2.3 Indigenous knowledge and learning

The acquisition of indigenous knowledge by any given community involves a process of learning and knowing. Indigenous knowledge have to be learned, respected, shared and received by people who come into contact with it. It must also be understood and disseminated to others within the community through generations (cf.7.2). However, the main question is: how does one acquire indigenous knowledge? Indigenous knowledge can be considered a product or commodity that is embedded in a particular place and is attached to a community that holds and practices it (Battiste and Honderson, 2000). Such a view confirms that indigenous knowledge is an essential part of the indigenous peoples who own and use it and pass it from one generation to another. Therefore, this knowledge should not be separated and must be disseminated holistically. Indigenous knowledge has to be incorporated in a form that is likely to be addressed by indigenous practices of knowing and learning (Tiu, 2007, p.26).

The process of knowledge acquisition within the community seems to be a cyclical process, in which one learns through the recreation of past experiences including “those of one’s ancestors and builds on prior learning and tradition” (McGregor, 2004, p. 388). This learning process is rooted in informal teaching methods in which various knowledge and skills are

learned and passed down throughout different generations (Tiu, 2007, p.26). The process of learning indigenous knowledge differs to some extent with that of Western contexts although there are some commonalities in the process of learning. For example, to achieve an outcome in learning indigenous knowledge, certain processes must happen in a specific order to achieve it. This is the same as someone undertaking a scientific experiment. Equally, indigenous knowledge is learned from many sources and includes observations and interactions with different objects and phenomena in one's environment (cf.7.1). Knowledge gathered in this way is clustered into three groups namely; traditional knowledge, which is transmitted from generation to generation; empirical knowledge, which is gained from daily observation; and revealed knowledge which is obtained through spirit and recognized as a gift (McGregor, 2004, p.388). Of these three categories, it is much more convenient to acquire traditional and empirical knowledge, since these forms of knowledge are observable. Revealed knowledge however, is frequently seen as personal knowledge obtained by having encounters with spirits. Such forms of knowledge are confined to specific individuals within a community. There are many sources, in which indigenous knowledge can be acquired, ranging from interpersonal experiences to perceived spiritual experiences (Tiu, 2007). Thus, the learning of indigenous knowledge is often guided by specific rules that govern the acquisition of knowledge within the community (McGregor, 2004). It is often personal knowledge that causes conservation practitioners to face difficulties in implementing their projects as they either fail to recognize the existence of this indigenous knowledge or if they recognize its existence, it is difficult for them to establish its sources. This can cause conflicts if the entirety of indigenous knowledge is not acknowledged (Tiu, 2007, p.28).

In the African context, indigenous methods of learning and knowing did not begin with the arrival of Western knowledge systems, and neither should their future depend exclusively on Western knowledge and worldviews. Similar to other human societies all over the world, all indigenous people have developed their own arrays of experiences and explanations from their surrounding environment for centuries (Kimwaga, 2010). This is because the way learning is perceived and how local communities actually learn is culturally specific. It has been argued that every community has different ways of experiencing social reality and, hence, learning (Matike, 2008). In fact the way local communities learn is influenced by their worldview and belief system which in turn is influenced by their natural environment, their socio-economic condition and ecological milieu of their livelihood. Therefore, locally specific ways of knowing and learning towards knowledge production are often referred to as

indigenous, ecological, traditional, community, local knowledge systems etc. (Kaya, 2015). Such knowledge includes sophisticated systems of information, understanding and interpretation that always guides their interactions with the natural environment; in farming and livestock keeping, fishing, hunting, natural resource management, health control, the naming and explanation of natural phenomena, as well as strategies to adapt to fluctuating environments (Semali and Kincheloe, 1999; Kante, 2004; Horsthemke, 2004).

Understanding the learning process of indigenous knowledge is important for this thesis as it illustrates how indigenous knowledge evolves and is passed from one generation to another (cf. 7.2). The learning process of indigenous knowledge is informed by nature since much of the coaching and learning process usually occurs on an ad hoc basis, in which the acquisition, interpretation and dissemination of indigenous knowledge happens at varied locations and settings depending on the activity being administered (Tiu, 2007, p.28). For instance, the skills of sowing beans and maize in the Haya community would be utilized in the home garden (*kibanja*),[4] while the grazing of livestock would occur at the pasture (*orweya*). Indeed, the learning by doing approach is very common in the acquisition of indigenous knowledge. This kind of learning takes place between the learners and the community, and enables learners of indigenous knowledge to be actively involved and hence become more knowledgeable toward their local environment (cf.7.2). Learning from direct experience and learning by doing gives learners a broader perspective of their environment (Simonelli, 1997).

### 2.4 Situated learning theory (SLT)

The theory behind the instructional approach of situated learning arises from the fields of psychology, anthropology, cognitive science and sociology (see Vygotsky, 1978; Dewey, 1981; Lave, 1988; Lave and Wenger, 1991; Greeno et al. 1992). Essentially, this theory demonstrates how learning or knowing certain knowledge within a particular community is embedded within the socio-cultural context of that community (cf.7.2). Situated learning scholars contend that knowledge must be learned or acquired in context and not in abstract. This theory accentuates the idea that much of what is learned is usually specific to the situation or event in which it was learned (Vincini, 2003). SLT examines learning as a fundamentally social phenomenon that occurs throughout everyday interactions. Such

[4] *Kibanja* (plural *bibanja*) is the name of the home gardens with a mixture of crops including banana as a dominant crop

learning interactions are produced by the social relations, cultural context, specific artefacts, and physical dimensions of the learning environment (Henning, 2008, p.143). Making a new contribution to the growing body of literature concerning SLT is not an easy task, but there is a need for refinement, particularly in the way this learning concept is used to study knowledge acquisition from a geographical perspective. Thus, this thesis uses SLT to explicate the process of learning and knowing indigenous knowledge within a Haya community.

SLT endeavours to portray the existing mismatch that exists between the knowledge learned from school *vis-à-vis* the knowledge learned from day to day experiences. As it has been discussed earlier, indigenous knowledge is culturally specific and is transmitted from one generation to another. The learning process of indigenous knowledge involves active participation as opposed to more passive methods often used in western learning. Students are actually more likely to acquire certain knowledge by actively participating rather than simply listening to teachers (Lave, 1988, p.9). This example illustrates that, a person learning indigenous knowledge is actively involved in addressing day to day community problems. Thus an individual learner becomes situated in the learning experience and knowledge acquisition becomes a part of the learning process as well as the culture from which the learning process evolved and is used (OTEC, 2007). The acquisition of indigenous knowledge thus includes daily interactions between people, culture, and environment. It is highly emphasized in situated learning that social interaction within the community is an important component since learners become actively involved in a community which utilize the behaviour and beliefs to be acquired (Lave, 1988).

SLT focuses on activities of daily living where learning occurs in social but informal settings. This view argues that that learning transpires through social relationships, within a cultural milieu by linking previous knowledge to present contexts (Lave and Wenger, 1991, p.14). SLT however emphasizes that learning should not be viewed as just a transmission of knowledge, but as a separate cognitive process. Such a method of learning is inspired by specific contexts (in which the learning is socially situated) and thereby particular physical environments (Lave, 1988). The process of learning indigenous knowledge is informal and usually occurs on a spontaneous basis whereby those who are learning are expected to learn by being a trainee in different community oriented activities (cf. 7.2). Survival often depends on the learning of indigenous knowledge in this context, thus, every person within the community has a social commitment to learn from the expertise of others so as to contribute

to the survival of their family, tribe and community (Tiu, 2007). For example, the preparation of traditional herbs for curing different diseases in the Haya community requires learners to participate in different stages of the process starting with the collection of herbs from the bushes in order to master the skills needed to prepare the herbs. This idea is supported by Cajete who argues that learning in an indigenous context is a communal social activity. The idea of learning as a communal activity implies that the learning process involved is situated learning because the situations, in which individuals learn are situated within cultural or social contexts (Cajete 1994, p.20).

Situated learning is not only applicable to learning indigenous knowledge, but can also apply to western knowledge if the learning process conforms to the socio-cultural milieu of a certain community. This view is corroborated by Rogoff (1990) namely, that a learning process that considers the cultural context of learners is important for learning any socio-cultural activity, since the relationship of personal development and social interaction cannot be isolated from the cultural setting of the learning. Additionally, learning processes can only be successful if learners are provided with the opportunity to co-participate with both participants and practitioners, and at the same time be integrated in all types of social activities that will provide the basis for learning to occur (Tiu, 2007, p.30). As emphasized by Lave and Wenger (1991, p.18), "co-participation enables people to gain access to modes of behaviour, eventually developing skills adequate to certain kinds of performance". In the process of learning western knowledge specifically for adaptation to climate change, local communities are constantly involved in co-participation so as to advance more their skills.

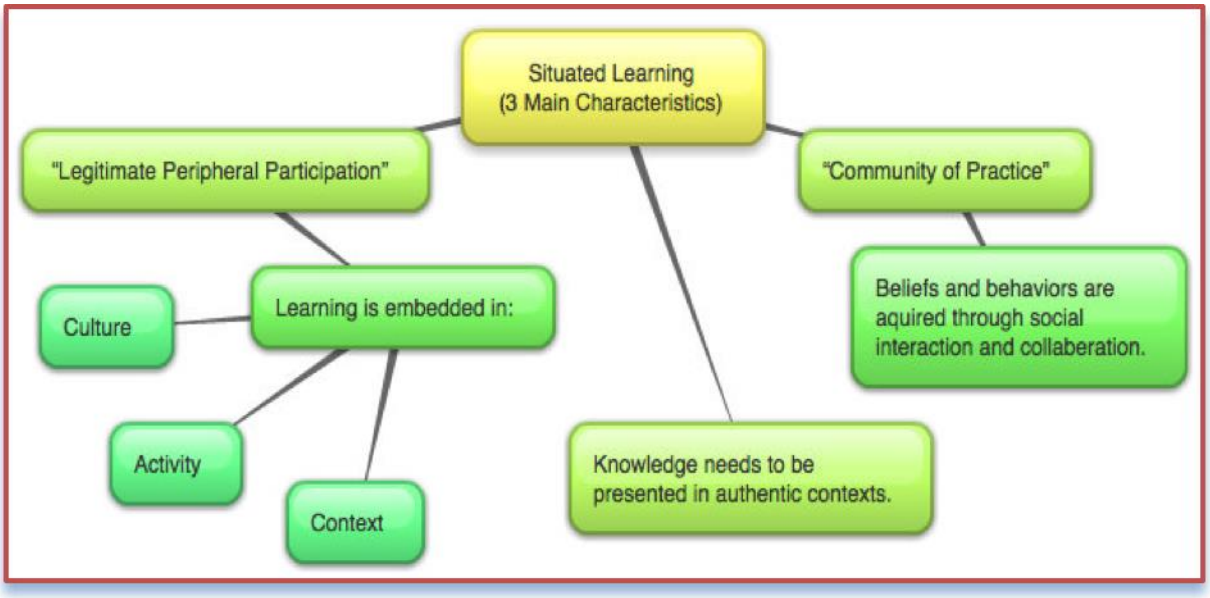


**Figure 1: Thematic representation of situated learning**

***Source*:** Based on Vygotsky (1978), and Lave and Wenger (1991)

### 2.5 Concepts and definition of adaptation

The adaptation of humans to changes in their physical environment has continued to be a dominant topic in social science adaptation literature (Garschagen 2014). Scholars like Denevan (1983, p.401) and Head (2010, p.235), have taken the approach of culture and cultural ecology in adaptation analysis to understand adaptation as "the process of change in response to a change in the physical environment or a change in the internal stimuli, such as demography, economics, and organization". Treating the adaptation concept in this perspective is of great relevance with regard to the different on-going changes facing communities inhabiting the Ngono River Basin. It has been argued that adaptation should not only be understood as the adjustment of ecological, economic or social systems in response to observed or expected changes (Adger et al. 2005, p.78). Rather, adaptation can also exemplify the way human actors optimize previous modes of adaptation under static conditions (i.e. the absence of change) in order to uphold their quality of life or capitalize on perceived available opportunities (Garschagen, 2014, p.55).

Furthermore, adaptation subsumes two aspects: building adaptive capacity (i.e. increasing the abilities of groups, individuals or organizations to adapt to changes), and implementing adaptation decisions (i.e. transforming that capacity into action). Both aspects of adaptation are important in preparing for or responding to the impacts caused by changing climates.

Thus, as argued by Adger, "adaptation is a continuous stream of activities, actions, decisions and attitudes that informs decisions about all aspects of life, and that reflects existing social norms and processes" (Adger et al. 2005, p.78). Understanding these aspects within the community is of great significance in order to understand their adaptive capacity, and how they implement their adaptive decisions to respond climate related hazards, as well as non-climatic hazards confronting them.

The concept of adaptation is not a new phenomenon in the field of climate change. Throughout human history, different societies have been adapting to natural climate change and variability by changing various aspects of their lifestyles such as their settlement and agricultural patterns as well as their economies. But human-related climate change gives a complex new dimension to this old age challenge (Burton et al. 2006, p.3). Adapting to changes by human being seems unique compared to that of animals or other organisms, whereby humans can only adapt reactively to existing changes and have the ability to plan and manage adaptation pro-actively, deploying, for instance, risk evaluations or some assessments of future changes (Adger et al. 2005, p.77). A large part of this adaptation is reactive, as it was caused by past or current changes, but there is also an anticipatory component for the assessment of future changes. Adaptation can also be autonomous at the local level or planned and coordinated by different actors at the regional, national or international level (*ibid*).

It has been argued that if adaptation to climate change is treated without care, adaptive actions can be rejected both politically and culturally at the local level (Pelling, 2011). Therefore, any adaption actions must accommodate the political and cultural context of the community where the adaptation policy is being undertaken. In recent years most adaptation policy has been framed by categorizing what is to be preserved and what is dispensable, instead of what can be reformed or gained. Leading development discourses usually give priority to the economy to be preserved, above cultural denigration or ecological wellbeing. The priority of economic factors over cultural or ecological development, presents a danger that "adaptation policy and practice will be reduced to seeking the preservation of an economic core, rather than allowing it to foster the flourishing of cultural and social as well as economic development, or of improved governance that seeks to incorporate the interests of future generations, non-human entities and the marginalized" (Pelling, 2011, p.3). Thus, this thesis considers multiple forms of adaptation as already recognized in the growing body of literature (see Adger et al. 2005; Smit and Wandel, 2006; Garschagen, 2014), and it

attempts to bring local adaption actions, particularly those supported by indigenous knowledge to the forefront of development discourse.

### 2.5.1 Contextual framing of adaptation approaches

The term adaptation started to be used around 1980s, but it became a widespread concept in relation to climate change after 1992 when it was first espoused in a UNFCCC document in 1992 (UN, 1992). The year 1992 can be considered the turning point when the concept of adaptation began to be applied widely and carry a diverse set of connotations and interpretations within the climate change field. The increase in the application of the term 'adaptation' alongside the growing tendency to take its relevance for granted, has eventually increased its conceptual ambiguity (Alemu, 2013). Therefore, there is no intelligible and comprehensive adaptation theory which creates different and often contested understandings of adaptation within academic and policy discourse (Schipper and Burton, 2009).

In the previous two decades, the term adaptation has been framed in a multitude of ways. The framing predominantly focuses on main two interpretations: reducing climate change impacts and reducing vulnerabilities (Mcgray et al. 2007, p.2). Existing literature usually makes a point of differentiating between these two approaches as the starting point of an analysis (Kelly and Adger, 2000; Smit and Pilifosova, 2001). These categories are frequently alluded to by different scholars using terms such as: 'first generation' and 'second generation' (Burton et al. 2002), 'top-down' and 'bottom-up' (Bhave et al.2014) or 'impacts-led' and 'vulnerability-led' (Adger et al. 2004, p.6). 'Vulnerability-led' and 'impact-led' approaches to adaptation have permitted a thorough understanding of the expansion and evolution of diverse interpretations of the adaption concept. In practice, adaptation examples fall between these two poles. This has contributed to the adaptation concept being espoused widely in various disciplines in order to refer to situations that require specialized responses (Alemu, 2013).

The adaptation process in any community is guided by a vulnerability-led approach as opposed to impacts-led approach to adaptation (Ensor and Berger, 2009). Generally speaking, the vulnerability-led approach of adaptation confines itself to reducing vulnerability as opposed to minimizing anticipated impacts of climate change. It is increasingly accepted by different scholars, policy makers and practitioners that, a successful vulnerability reduction will be achieved if adaptation converges with development. There are different factors and processes, which drive vulnerability including socio-economic and political factors (Warrick,

2011, p.37). Conversely, in the field of climate change, vulnerability has a conceptual framework that preserves the idea of adaptation as something that is different from development processes. Its conceptual framework deviates somewhat from its origins in disaster risk reduction and development. Despite widespread vulnerability-led approaches to adaptation such as local community adaptation actions, there does not exist an agreement on the conceptual connotations of these terms within mainstream international adaptation discourse, (Schipper, 2007, p.8).

In recent years, the concept of adaptation has been increasingly intertwined with vulnerability and other associated concepts of adaptive capacity and resilience. Such associations have brought in theories and practices from non-climate change fields that have employed the concepts in a coherent way. The handling of the term adaptation has not changed completely, rather, fundamental practices and assessments have changed and expanded over time as the adaptation field continues to grow and increase in complexity (Warrick, 2011, p.17). In their article titled *Anatomy of Adaptation to Climate Change and Variability*", Smit et al. (2000, p.224), explicated what exactly the concept of adaptation connotes and how it has been characterized by contemplating three basic questions: Adaptation to what? Who or what adapts? How does adaptation occur? Using these three basic questions as a basis, I will synthesize the roots of climate change adaptation more deeply by focusing on the impacts-led approach to adaptation and its shortcomings in the next sections.

### 2.5.2 Impacts-led approach and the rise of climate change adaptation

The roots of climate change adaptation can be found by understanding the impact-led approaches to adaptation. Various scholars have used different paradigms to refer to the impacts-led approaches, utilizing terms such as the "standard approach" (Burton et al. 2002), the "top down" approach (Dessai et al. 2004, p.13) and the "conventional approach" (Smit and Pilifosova, 2001). Though these approaches seem to have varied terminologies, their perspectives usually share similar distinctive features, and have been dominant in adaptation research since the 1990s (Burton et al. 2002; Schipper, 2009). The impacts-led approach continues to prosper and was also made clear in the Fourth Assessment Report of the IPCC (AR4), in which impacts led approaches were used in the Working Group Two (WG2) report (Carter et al. 2007).

The impact-led approach has a foothold in the domain of mitigation policy. Initially, the adaptation concept was not given much attention in the discourse of global climate change, as

most of the emphasis was placed on mitigation actions (Apuuli et al. 2000). This was because developed industrialized countries have historically placed emphasis on climate change mitigation rather than climate change adaptation (Ayers and Dodman, 2010, p.163). Accordingly, impact studies were perceived as the crucial approach to assessment for adaptation, as there were intimately related to the mitigation policy domain. Likewise, it has been observed over the past two decades that the apparent policy relevance and purpose for adaptation has changed. Currently adaptation is moving from being the "handmaiden to impacts research in the mitigation context" (Burton et al. 2002, p.145), to having its own distinct line of policy agenda. This has resulted in an increasing appearance of other non-impacts-based approaches to adaptation (Warrick, 2011). Impact study was intended mainly to address the ultimate objective of the UNFCCC, as Article 2 requires the prevention of dangerous interference with the climate system hence the stabilization of atmospheric Greenhouse Gases (GHGs) concentrations at levels and within a time frame sufficient to permit ecosystems to adapt naturally to climate change (Burton et al., 2002). This would be achieved by requiring member states to;

> […] formulate, implement publishing and regularly update national, and where appropriate, regional programs containing […] measures to facilitate adequate adaptation to climate change, as clearly stated in Article 4.1 (b) (UN, 1992 cited in Alemu, 2013, p.17).

It is essential to understand what constitutes dangerous climate change when ascertaining its impacts. Thus, adaptation policy focuses on reducing the impacts caused by climate change, thereby moderating the existing dangerous changes in climate together with mitigation efforts (Burton et al. 2002). During the inception of impact assessments in the 1990s, adaptation was viewed as an alternative to mitigation. This view seems to have had a timely arrival as considerable effort is currently directed towards the reducing of greenhouse gas emissions. The primary focus of impact analyses during this time was to maintain an optimal balance between adaptation and mitigation measures, in mitigation policy (Warrick, 2011). The impact-led approach was expected to address several issues like "the extent of the climate change problem" and "the comparison of the costs of climate change with the costs of greenhouse gas mitigation" (O'Brien et al. 2004, p.3). Focusing on such issues has resulted in the consideration of mitigation, adaptation and impacts by the same working group. This is reflected in the Second Assessment Report (SAR) of the IPCC (Watson et al. 1995).

The impact-led approach focuses on determining the impacts of climate change and the resulting damage costs (Parry and Carter, 1998). In this respect, adaptation was designed as a specific measure to address the impacts of climate change. It is expected that adaptation measures will moderate adverse impacts and enhance positive opportunities (Tol et al. 1998, p.110). Therefore, the overarching objective of the impacts-led approach is to evaluate the damage-costs of climate change and the changes, which adaptation measures could bring (Smit and Wandel, 2006, p.282). Despite the wide use of the concept of adaptation in climate change politics, impact-led approaches still dominate the understanding of adaptation (Warrick, 2011). The dominant impact-led perception of adaptation is a result of the dominant international climate policy agenda, which is specifically mitigation-oriented due to the emphasis placed on mitigation by developed countries (Schipper, 2009). Mike Muller confirms this by pointing out that with respect to the global warming and related climate variability predicted to occur over the next century, more emphasis is placed on actions to mitigate climate changes than actions to adapt to climate change impacts that have already occurred (Muller, 2007, p.111). For example, it is clearly stated by the UNFCCC that the leading objective is to reduce the emissions of greenhouse gas. With this existing framework addressing adaptation is too complex (Pielke, 2005; Ford, 2009).

The impact-led approach to adaptation failed to provide concrete solution for successful adaptation measures in developing countries, as pointed out in Article 4 (4) of the UNFCCC. It was recognized that continuing with mitigation efforts during this time would be insufficient to prevent "dangerous climate change" and thus, it was thought that adaptation efforts would be necessary due to the existing presence of GHGs in the atmosphere, which required immediate intervention to eliminate. This decision was a turning point for adaptation as it took a new foothold and was viewed as a complement to rather than an alternative to mitigation (Warrick, 2011, p.26).

### 2.6 The rise of the vulnerability approach in adaptation research

Increasing international negotiations led by developing countries, contributed to the rise of the vulnerability-led approach to adaptation (Warrick, 2011). This increased an urgency to incorporate provisions for adaptation and adaptation policy as shown in 2001, when the parties to the UNFCCC accepted the *Marrakech Accord* during their seventh conference (COP-7) (Huq et al. 2004, p.19). The conference created two new funds (plus the adaptation fund under the Kyoto protocol), to be managed by the Global Environmental Fund (GEF) in addition to its climate change focal areas. These funds were expected to finance different

projects related to; technology transfer, climate change mitigation, capacity building adaptation and economic diversification for countries highly reliant on income from fossil fuels. The role of the GEF was to implement the provisions of the *Marrakech Accord* in a way that respects both procedural fairness and reflects the priorities of developing countries in seeking to adapt to climate change. The *Marrakech Accord* gave recognition to different issues encountered by developing nations within the international climate change regime and brought the concepts of vulnerability and development to the forefront of adaptation scholarship (Adger et al. 2003, p.191). The focus of adaptation studies was shifted to the procedure of adaptation and how adaption funds should be allocated in selected adaptation activities. This is clearly reflected in Article 4.4, which specifies the need for increased financial assistance for adaptation actions in order to curb the effects of climate change in developing communities most seriously impacted by the effects of climate change (UN, 1992 cited in Alemu, 2013, p.19).

Therefore, the great attention focused on impact-led approaches to adaptation paved the way to a focus on vulnerability-led approaches to adaptation. In this respect, there was a shift in terms of the objectives and anticipated outcomes of adaptation. However there now arose a need to agree on the premises of adaptation assessments and adaptation itself was required to address different conceptual complexities through the lens of the vulnerability-led approaches to adaptation (Warrick, 2011). Similarly, the vulnerability-led perspective was required to address principal questions concerning who is vulnerable to climate change and why, as well as find different mechanisms to address the vulnerabilities within the community (O'Brien et al. 2004, p.3). This has shifted the focus from determining the extent to which adaptation can reduce the need for mitigation, towards creating policies which are designed and formulated by consulting a multiplicity of stakeholders (Burton et al. 2002; Carter et al. 2007).

The headway made towards the adoption of the vulnerability-led approach requires the consideration of the socio-political, economic, cultural and institutional context where adaptation to climate change is being executed rather than a focus on the climate stimulus alone (Ensor and Berger, 2009). In a similar perspective, Adger et al (2003, p.181) argued for a reflection on the wider socio-political, economic, cultural, institutional, and environmental context that regulates how different people within the community respond to and cope with climate change impacts (cf.5). In contrast to impact-led approaches, the vulnerability-led perspectives put emphasize on both, the broad structural forces and conditions of a specific area that limits the ability of that area to respond to climate stimuli

(Smit and Pilifosova, 2003; Adger et al. 2004; O'Brien et al. 2004; Smit and Wandel, 2006; Ensor and Berger, 2009). From this backdrop, the vulnerability-led approach to adaptation has formed the basis of current adaptation research and policy initiatives for various institutions and organizations such as the Adaptation Policy Framework (APF), United Nations Development Programme (UNDP), (Lim et al. 2004), the National Adaptation Plans of Action (NAPA) guidelines (UNFCCC, 2002) and the Assessments of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors (AIACC) programme (Leary et al. 2008). The focus of these initiatives is to develop means of reducing climate change vulnerability in developing countries through adaptation processes that are closely linked to sustainable development (Wilbanks, 2003).

### 2.7 Interpretations of the vulnerability concept in climate change research

The framing of the vulnerability concept in the field of climate change has created ambiguities, which results in different understandings of the concept (Brooks, 2003; Füssel, 2007). Different meanings of vulnerability are manifestations of diverse discourses that do not only indicate different approaches to science, but also differing political and social reactions to climate change (O'Brien et al. 2007, p.74). The concept of vulnerability has a variety of definitions provided by different scholars (see Bohle et al. 1994; Cutter 1996; Brooks 2003). Similarly, the growing body of literature provide different varieties of interpretations and alternative concepts of vulnerability. Different interpretations of vulnerability can be found among various scholarly communities and research fields. Usually, the concept of vulnerability is primarily associated with epistemological and methodological variations of different fields involved in vulnerability studies (Cutter, 1996, p.530).

In climate change research, various authors have looked at how the concept of climate change relates to the concept of vulnerability (see, for example, Brooks, 2003; Füssel and Klein, 2006; Adger 2006; Füssel 2007). This has resulted different concepts and interpretations of the character and cause of vulnerability, which produces different types of knowledge and consequently strategies for reducing vulnerability (Kelly and Adger, 2000; O'Brien et al. 2007; Füssel, 2007). However, the broad characteristics of different interpretations of the concept of vulnerability can be quite perplexing, particularly in climate change studies, where researchers and other interested stakeholders with different background knowledge work together (Fellmann, 2012, p.42). It is thus important to understand some of the different interpretations of the concept of vulnerability in the context of climate change (Janssen and

Ostrom, 2006; Eakin and Luers, 2006). Some of the most popular interpretations of vulnerability in the context of climate change include 'outcome' and 'contextual' vulnerability, which sometimes referred to as end-point and the starting point of the analysis respectively. Both concepts are graphically presented in Figure 2.

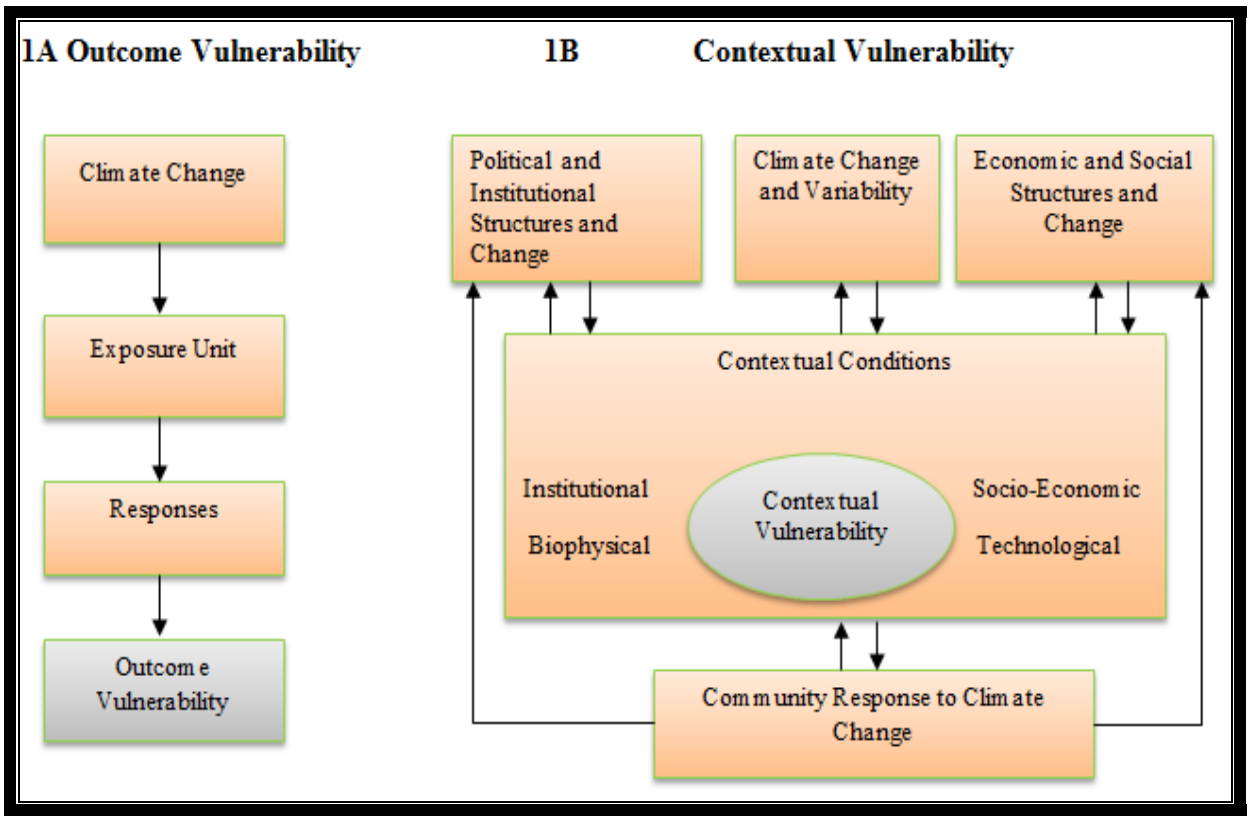


**Figure 2: Framework indicating interpretations of vulnerability to climate change**

**Source:** Based on O'Brien *et al* (2007)

Outcome vulnerability (sometimes known as the 'end-point" interpretation) is a concept that considers vulnerability in climate change study and policy to be the total impacts caused by climate change, which remained after adaptation action has taken place (McFadden et al. 2007). Therefore, outcome vulnerability usually combines information regarding potential biophysical climate impacts with information on the socio-economic capacity of a community to adapt to climate change impacts (Kelly and Adger, 2000; O'Brien et al. 2007; Füssel, 2007). This approach is grounded in natural science and future climate change model scenarios and focuses on biophysical changes in closed or at least well-defined systems.

Within this approach, the boundaries between 'nature' and 'society' can be drawn and vulnerability is an outcome that can be measured and quantified. Usually, the adaptive capacity of a system determines the magnitude of outcome vulnerability. Despite the fact that the adaptive capacity of a system determines its outcome vulnerability, the role of socio-economic facets in modifying the impacts of climate change is highly marginalized since more emphasis is given to biophysical components. Consequently, the most vulnerable systems are often considered to be those that will experience the most dramatic physical changes (Fellmann, 2012).

Studies that follow an outcome vulnerability approach usually focus on technological solutions for adaptation and mitigation strategies to reduce certain effects of climate change (Brooks 2003; Füssel 2007). Research in this area is typically confined to investigating changes related to GHG emissions and focusing on measurable impacts based on future general circulation model conditions (Demerrit, 2001, p.310). In this framing 'nature' and 'society' are completely detached and the emphasis is disproportionately placed on 'nature' as part of the earth system (Castree, 2001). Within the scientific framing of climate change, the society is viewed in terms of one box that influences the process of climate change and experiencing its consequences. Here, vulnerability is understood as the negative climate change impacts experienced by a certain exposure unit that can be measured and quantified. The solution is often portrayed as being a technical adaptation measure such as the reduction of greenhouse gas emissions (O'Brien et al, 2007, p.76). For example, studies that focus on the vulnerability of agricultural products to climate change tend to follow an outcome vulnerability approach and prescribe typical technological remedies for adaptation in the agricultural sector such as the use of different water management systems, different crop seeds or different production techniques (Peltonen-Sainio, 2012).

The 'contextual vulnerability' approach (sometimes known as 'starting point' interpretation) emphasises social or 'non-climate' factors as creating conditions where a certain community is unable to effectively adapt to climate change (Warrick, 2011, p.41). In this approach, vulnerability is seen to be influenced by altering biophysical conditions as well as changes in social, economic, political, institutional, and technological structures or processes. Therefore, in the contextual interpretation, vulnerability is characterized as a function of ecological and social systems that are determined by multiple factors and processes (Adger 2006; O'Brien et al. 2007). This approach clearly recognizes that vulnerability to climate change is not only a consequence of biophysical events but is also influenced by the socio-economic context in

which climate change occurs (see chapter 5). The contextual approach emphasizes strengthening the ability of the vulnerable community to cope with stresses and shocks to their environment. This implies that adaptation and vulnerability is linked to broader environmental and social conditions and not climate change impacts alone (Kelly and Adger, 2000; Füssel, 2007; Ensor and Berger, 2009). Thus, vulnerability reductions under the contextual approach can be achieved by modifying the contextual conditions in which climate change occurs so that individuals and groups are supported to better adapt to changing climatic risks (Adger, 2006; Eakin and Luers, 2006; O'Brien et al. 2007; Eriksen and Kelly, 2007). In this respect, a successful reduction in vulnerability to climate change and environmental challenges would therefore need development initiatives that are attuned to socio-economic needs a community, as well as environmental sustainability that will increase their adaptive capacity to deal with climate change-related vulnerabilities (Fellmann, 2012). Given that various parts of the world have ecological limits, there should be new opportunities and technologies in developing countries in order to achieve economic development and environmental sustainability. This will need thorough innovative strategies that move the emphasis from economic growth towards strong international financial and institutional support, and a shift to valuing indigenous or local knowledge systems (UNFCCC, 2011).

As explained above, climate vulnerability is characterized as a function of biophysical and socio-economic vulnerabilities, whereby each is defined by the three dimensions of exposure, sensitivity and adaptive capacity. Once these dimensions are combined with a specific likelihood of occurrence that can be aligned to either biophysical or socio-economic changes, climate vulnerability becomes climate risk (Preston and Stafford-Smith, 2009).

## 2.8 Conceptual framework

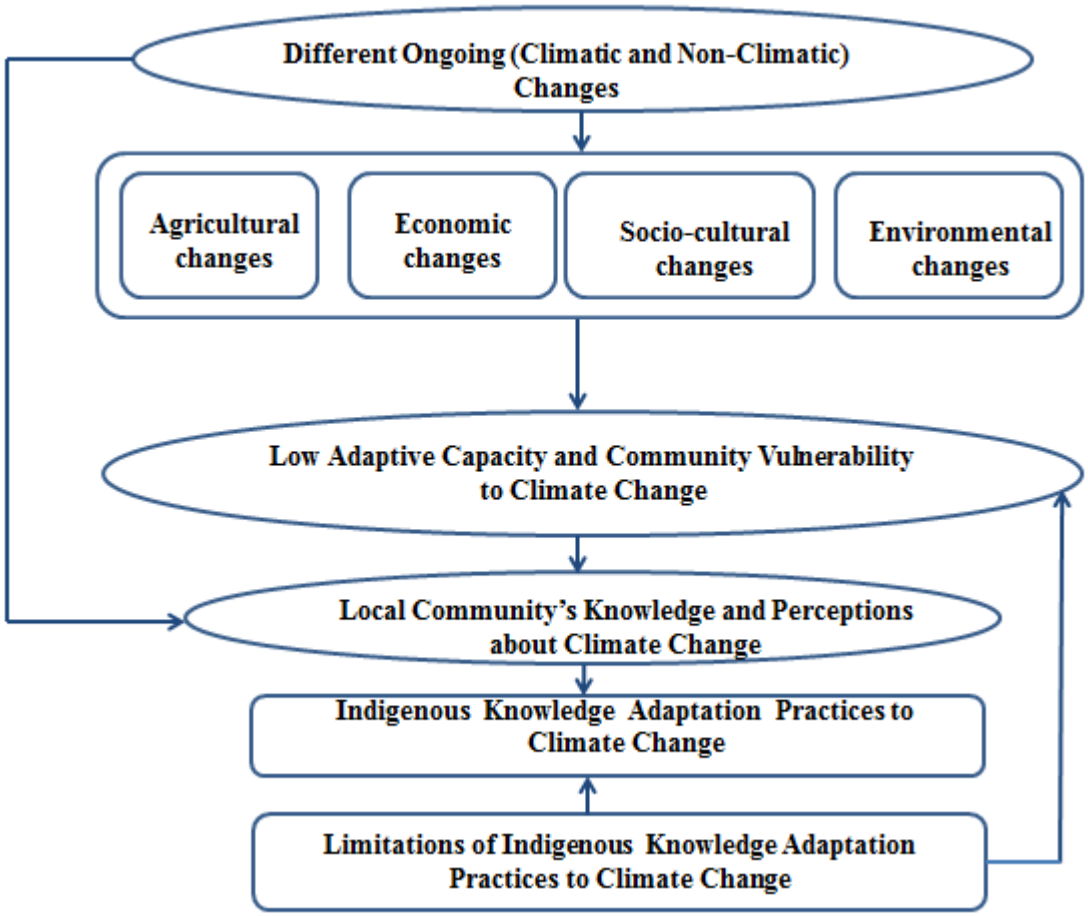


**Figure 3: Conceptual framework**

***Source*:** *Own draft (2016)*

The vulnerability of a system, individual or community refers to its exposure to stress and difficulty it has in handling them (Philip and Rayhan, 2004, p.5). Social scientists view vulnerability in terms of a series of social and economic factors that determine people's capacity to cope with stress or any emerging change (Allen, 2003, p.182), on the other hand, climate scientists usually view vulnerability in terms of the likelihood of a climate-related incident occurring and impacts of that possible incident (Nicholls *et al*, 1999). This study follows the contextual vulnerability interpretation as different on-going (climatic and non-climatic) changes contribute to community vulnerability in the Ngono River Basin.

The starting-point analysis of contextual vulnerability provides an understanding of non-climatic factors and social processes that constrain people's adaptation capacity to deal with climate change. Since, vulnerability manifests itself even in the absence of a certain physical hazard, the wider socio-economic conditions that hinder or enable people's adaptation practices should be the starting-point of vulnerability analysis (Alemu, 2013). The above conceptual framework depicts different on-going changes (climatic and non-climatic) have translated to further changes including; agricultural, economic, socio-cultural, and environmental in nature which in one way or another contribute to low adaptive capacity and community vulnerability to climate change. The evidence shows that different on-going changes cause different risks within the community (cf. 5). Those risks intersect with climate risks to produce impacts, which ultimately increase community vulnerability (cf. 6.3). Within the Haya community, the capacities of individuals and social groups to deal with those impacts have been decreasing, and this increases external stress on their livelihoods and well-being.

Accordingly, in this research I examine the local community's perceptions of climate change. The objective is to get insights from the local communities concerning the way they perceive and make sense of local climate related risks at the community level. I looked at how climate related risks are constructed based on the different experiences held by various community members (cf. 6.1). It is also important to understand how different risks are conceived, prioritized and managed within the community. An understanding of climate risks of a certain community plays an important role in how climate change is perceived at the local level (see Granderson, 2014, p.57). In addition, the nature and magnitude of climate change risks vary considerably from one community to another. Even within a single community, the climate change risks can differ due to the differences in livelihoods. For instance, resource-dependence livelihoods, such as agriculture, herding, fishing and hunting, are exposed to climate risks such as recurrent drought, heavy rains, sea level rise and invasive species (see Salick and Byg, 2007). In this study, local communities were able to express their views regarding the changes of the local climate by focusing on the major elements of weather such as temperature, precipitation and wind events (cf. 6.1.2). Apart from being able to explain their perceptions, local communities were able to explain the causes and impacts of climate related risks (cf. 6.2 and 6.3).

Adaptation to climate related risks within the Haya community is an on-going process. The Haya people in the Ngono River Basin are sensitive to climatic related risks and other stresses due to different on-going changes to their environment they have been experiencing for the last 30 years. Irrespective of being affected by these impacts, the level of sensitivity usually varies among individual households. As emphasized by Bizikova et al. (2009, p.8), sensitivity and adaptive capacity are context specific and both differ from country to country, community to community, amidst social groups and individuals. Adaptive capacity in this thesis is referred as the ability of the community to manage all the negative impacts of climatic and non-climatic changes. It depends on learning new knowledge and applying indigenous knowledge to respond to threats and risks. It includes the ability of the individual to cooperate within their households, as well as with neighbours and local leaders in decision making processes (cf. 7.2). From this backdrop, if an adaptive capacity is depleted and the sensitivity of a community to climate change and variability is high, this will increase the community's vulnerability to climate change. On the other hand, if the adaptive capacity is high and the community is less sensitive to climate change impacts, then adaptation will be more successful.

Irrespective of adaptive capacity held by the local communities, there are some barriers to adaptation particularly in the use of practices derived from indigenous knowledge. These challenges tend to undermine the efforts of local communities, s to swiftly adapt to climate change impacts. This also increases their vulnerability to the impacts of climate change. These barriers include: the poor recognition of indigenous knowledge, the decrease of indigenous knowledge custodians within the community, the absence of knowledge sharing culture, socio-economic transformation, vanishing of traditional culture and practices, unevenly distribution of indigenous knowledge, vanishing of indigenous seeds, plant species and traditional medicinal, as well as exclusion of indigenous knowledge in the formal adaptation practices.

### 2.9 Summary of the guiding research questions

This thesis is organized into four major conceptual pillars. First, various on-going (climatic and non-climatic) changes as observed by local communities in the study area are discussed. This chapter attempts to assess different sources of community vulnerability using starting-point vulnerability in order to understand how different on-going changes can contribute to community vulnerability and undermine a community's adaptive capacity. Second, local community perceptions of the changes in their local climate are addressed in order to

understand how local communities make sense of what they observe. Third, everyday practices related to climate change adaptation are explained to show how the communities in the Ngono River basin respond to climate related risks using indigenous knowledge. This chapter will explore different adaptation practices, which are predominantly embedded into socio-cultural context of the Haya as well as the way people in the community gain knowledge to adapt to climate change. This chapter will also examine the way indigenous knowledge is transmitted from one generation to another. Fourth, the relevance, hegemony and challenges of indigenous knowledge in climate change adaptation will be discussed. These four major conceptual pillars and the guiding research questions below provide the structure for the empirical chapters of this study.

**Confronted with Change** **[Chapter 5]**

***What changes have been observed by the local communities for the last 30 years?***

1. What kinds of changes have you observed in recent years in your village?
2. What are the causes of these observed changes?
3. What are the main disasters caused by these changes experienced by local communities in the past 30 years in this village?

**Making Sense of Climate Related Risks [Chapter 6]**

***What is the local community's knowledge about the perception of climate change?***

1. What changes have you observed in the local climate of this village for the past 30 years?
2. What are the causes of climate change in this village?
3. In which ways are the changes in local climate affects local community's livelihoods activities?

**Everyday Practices to Deal with Climate Related Risks [Chapter 7]**

***How do local communities use different indigenous knowledge and practices in the face of extreme weather and climate related stresses?***

1. What are the indigenous adaptations practices to climate change impacts on different livelihood activities in this village?
2. Where did you learn these indigenous adaptation practices to climate change?
3. Which type of knowledge is used by the community to adapt to climate change is more dominant in this village?

**The Relevance and Challenges of Indigenous Knowledge in Climate Change Adaptation [Chapter 8]**

***What are the barriers of applying indigenous knowledge and practices in the face of climate related risks?***

1 What are the relevancies of using indigenous practices on climate change adaptation?

2 What underlying challenges do you face in using indigenous practice to adapt to climate change?

3 How these challenges can be solved?

4 What are your suggestions on how to promote and improve indigenous adaptation practices for effectively adaptive capacity at local level?

# Chapter Three

## Research Design and Methodology

This chapter presents the research design and methodology employed in this thesis. In particular, it explains the methods I developed to enable me to address the overarching research question: **How do local communities experience and adapt to vulnerability and climate change using indigenous knowledge in the Ngono River Basin, Tanzania**? This objective required field observation and Participatory Rural Appraisal (PRA). Major inputs were obtained from local communities regarding farming and livestock activities throughout their agricultural almanac. Other inputs were obtained from research scientists who work on climate related issues, field extension staff and from third parties supporting the local communities, such as the government and non-governmental organizations (NGOs). The involvement of local communities in this study was imperative as it gave them an opportunity to present their views. To establish the scientific basis of indigenous knowledge, the participation of farmers and livestock keepers was necessary.

Determining the way indigenous knowledge is produced, mediated, changed, as well as disseminated from one generation to the other was also important. This study was conducted in two phases: the first phase covered a period of five months from August 2013 to December 2013, while the second phase covered a period of three months from September 2014 to November 2014. The chosen study period ensured that most of the farming activities involved in the preparation of the land up to the harvesting of perennial and annual crops grown in the *Kibanja* and *Musiri*[5], were involved in the observation. Livestock keeping activities which included grazing of animals such as cows, sheep and goats were also involved in the observation. A prior preliminary survey of the study area was undertaken to establish the methods for data collection that would be suitable to answer the research questions (see Lado, 2004). A triangulation technique was employed throughout the research process in order to address the research questions. Primarily, data collection involved questionnaire surveys, personal interviews, participatory observations, participatory rural

[5] *Musiri* refers to a small plot of a cultivated land with annual crops separate from the *Kibanja.* In plural form it is known as *emisiri*, these plots are important among Haya community as they provide the family with important supplementary food. The *omusiri* plot sometimes can be close to the *kibanja,* but most of emisiri (Plural) are located in the outskirts of the villages where farmers pay regular visits to these plots. Crops cultivated in *musiri* include cassava, sweet potatoes and yams in shifting cultivation system.

appraisals (PRA), and documentary review. All questionnaires and interview questions had to be pre-tested and edited before used in the field.

### 3.1 Philosophical approach of the study

This study does not confine itself to any one system of philosophy and reality or in other words, this study follows neither a pure positivist nor a pure constructivist approach. While the constructivist approach is important for understanding indigenous knowledge and practices used by the local communities to adapt to climate change risks, it needs to be complemented by a realist perspective when it comes to the assessment of other research objects such as the status of rains and temperature whether it has increased or not increased, both. Thus, this study uses an approach that acknowledges the relationship of the objective existence of phenomena as well the social interpretation and construction of their meaning and the social processes to deal with them (see Garschagen, 2014, p.164). Hence this study uses the pragmatism approach (see Reichardt and Cook, 1979; Tashakkori and Teddlie, 1998; Patton, 2001), which uses mixed method research (MMR) for applied research questions by sharing many assumptions and prepositions of critical realism while maintaining the social aspects of the constructivism approach (Giacobbi et al. 2005; Garschagen, 2014).

Within MMR, there is a widespread view that the suitable philosophical "spouse" for qualitative research is constructivism, and for quantitative research, post-positivist empiricism (Johnson and Gray, 2010). Such an understanding would appear to make MMR a philosophical oxymoron, or at least a difficult blending. Constructivism and post-positivism clash on major issues regarding the nature of the objects of research and our knowledge of them (Guba and Lincoln, 1989), resulting in the so-called "paradigm wars" between qualitative and quantitative methods. However, the pragmatism approach argues that existing philosophical disagreements are not important, and that research methods are not essentially linked to a specific philosophical position. Therefore, methods can be blended on the basis of their practical usefulness, and paradigmatic battles can be ignored (Maxwell and Mittapalli, 2003). Such view has gained considerable acceptance within the MMR community and pragmatism is increasingly promoted as the suitable philosophical stance for mixed method research (Maxcy, 2003; Morgan, 2003; Tashakkori and Teddlie, 2003).

However, pragmatists have the tendency to underestimate the real influence of philosophical assumptions on research methods, which is quite significant when blending qualitative and quantitative approaches. Epistemological, ontological and axiological assumptions are actual

properties of researchers and evaluators (Henry et al. 1998). These assumptions unavoidably influence researchers' purposes and actions to some extent, and are not easily changed or abandoned. This makes a strong argument for blending qualitative and quantitative paradigmatic positions, as well as methods, in MMR to focus on the complementarity of the two research approaches (Maxwell and Mittapalli, 2003). Both research approaches have diverse strengths and limitations, and using them concurrently allows a researcher to draw conclusions that would be difficult to reach using a single approach. Different sources of MMR list the comparative strengths and limitations of qualitative and quantitative research approaches, and use them to develop approaches for blending the two. Such lists are typically dichotomous, and the features of each approach are presented as uniform, polar, and complementary (*ibid*).

Qualitative and quantitative research approaches have both been applied individually in both the social and natural science communities long before the mixed approach was introduced. The quantitative research approach which falls within a positivist philosophical paradigm is normally undertaken through experimental, non-experimental or survey designs. On the other hand, the qualitative research approach which falls within constructivist philosophical paradigm is normally grounded in in-depth and detailed inquiries of issues using narratives, ethnographies, phenomenologies, case studies and similar sources (Creswell, 2003). Much of the knowledge in this thesis was obtained from qualitative research elements; however, quantitative approaches were used to complement these findings. Thus, this study firstly conducted qualitative research, in which the social constructivism approach was largely employed. This philosophical approach was used to understand the way local communities through their participation in social processes enact their particular realities and provide them with meaning, and show how these meanings, beliefs and intentions of the local communities help to shape their adaptation actions. This methodological approach was helpful to me as I was able to understand the local community's views of the social world and their role in it (cf. 3.5.1). The quantitative approach was later utilized with household surveys using standardized questionnaire with selected samples (cf. 3.5.2).

Each of the two methods has both strengths and limitations which using both qualitative and quantitative approaches together is the best way to bring in the best qualities for each one of them (Jick, 1979). Various scholars have outlined the advantages of using a MMR for various reasons. Firstly, it allows flexibility for the researcher with respect to investigative techniques, which allows different emerging questions to be solved without being bound by

either quantitative research or qualitative research. Second, it upholds teamwork among researchers without taking into consideration the differences in terms of philosophical orientation. Third, it views research from a holistic viewpoint (Lincoln and Guba, 1985; Newman and Benz, 1998) and fourth it has the ability to blend macro and micro levels of research while combining qualitative and quantitative aspects of research within a single scientific investigation (Ndaki, 2014, p.57). The use of the MMR approach in this study was useful as it ensured that all research questions were comprehensively answered through using many sources of information.

### 3.1.1 Case study research design

Case study research design refers to the process which aims at investigating a contemporary phenomenon within its real life context, particularly when boundaries between phenomenon and context are not clearly evident (Yin, 1994, 2003). This design combines data collection methods such as questionnaires, interviews, and documentaries as well as text analysis. Both quantitative methods (mostly involving numbers and measurements) and qualitative data collections and analysis methods (mostly involving words and interpretation) may be used (Yin, 1994, p.14). The major objective of this case study researcher is to develop a profound understanding of actors (in a specific case) through their interactions, sentiments, and behaviours over a specific period of time (Woodside, 2010).

The case study research design has the following characteristics according to Mills; "interrelationships constituting the context of a specific entity (a case); analysis of the interplay between background factors and the entity being studied; and the clear purpose of using insights (of interactions between contextual relationships and the relevant entity) to generate theory and/or contribute to existing theory" (Mills, et. al. 2010 cited in Ndaki, 2014, p.58). One of the principal features of case study research is the use of various sources of evidence, each with their own strengths and weaknesses since any one source of evidence is unlikely to be appropriate on its own (Gillham, 2000). This is crucial in ensuring the validity of the data, in which the strength of one source can counterbalances the weakness of another (Becker et al. 2015). Moreover, in case study research designs, pre-conceived notions or theoretical ideas (*a priori*) are not applicable. Until the researcher gets involved in data collection and understands the setting of a certain phenomenon it is difficult to know which theoretical explanations, will be applicable or make the most sense for that specific case (Gillham, 2000). The case study research design is applicable: when researchers are aiming to

respond to question such as how or why, when the researcher has little control over the events being observed, and when there is a contemporary focus within actual life context. This research design is also worthwhile when there is a need to cover contextual situations that are pertinent to the phenomena under study or there are blurred lines between the phenomena and the surrounding context (Yin, 2003, p.4).

One of the key strengths of a case study research design is its variation in terms of basic, instrumental and collective methods, which allows for both quantitative and qualitative analyses of the data. Longitudinal research of individual subjects, for example, can depend on qualitative data from journals, which give descriptive accounts of behaviour. On the other hand, there are different case studies, which use evidence from both the statistical and categorical responses of individual subjects (Hosenfeld, 1984 cited in Zaidah, 2007, p.4). However, the thorough qualitative accounts, often produced in case studies do not merely assist to explain the data in real-life environments, but also help to describe the difficulties of the real-life situations, which may not be captured through experimental or survey research (Zaidah, 2003). Despite these strengths, a case study research design is not free of limitations as it has received criticism from a number of scholars (Yin, 1994, 2003; Baxter, 2008). Some of the strongest criticisms were presented by Yin (1984), who accused case study research design of lacking rigour. He notes that "too many times, the case study investigator has been sloppy, and has allowed equivocal evidence or biased views to influence the direction of the findings and conclusions" (p. 21). Additionally, this research design is often considered too long, problematic to conduct, and generating unwieldy amounts of documentation (Yin, 1984).

Based on the pragmatist philosophical approach, this study employed an MMR approach with case study methods, in which both qualitative and quantitative research approaches were combined in the form of triangulation (cf. 3.1.2). In this respect, both qualitative and quantitative research approaches were used to collect data in the two phases of data collection in the study area. Under the umbrella of qualitative methods, interviews were conducted with experts, selected elders, famous people within the community, and local leaders, while focus group discussions and PRA were also conducted with selected farmers and livestock keepers. In terms of the quantitative research approach, data collection was conducted through household questionnaires, which were administered to farmers and livestock keepers in the study area.

### 3.1.2 Triangulation and its operationalization

Triangulation not only refers to the use of different research approaches, but more precisely to the blending of complementary means of data collection and theory building in order to improve the quality, and indeed the validity, of empirical research (Etzold, 2012, p.101). Five types of triangulation have been widely discussed in literature (see Meijer and Beijaard, 2002, p.146; Hoggart et al, 2002, p.67; Hussein 2009, p.3). The first is 'data triangulation', which refers to a process of data collection which uses different sampling strategies, so that slices of data which examine certain variables such as different points of time, varieties of people and social situations can be collected. In this study, data triangulation involved the collection of data at different scales of analysis, starting from; the national level (e.g. Vice President Office Environmental Division), the district council (e.g. District Agriculture Office Unit, District Environmental Office Unit), and the local level (e.g. village leaders, farmers and livestock keepers) in order to gain insights regarding different on-going changes at different scales. It also involved assessing various perspectives including those of the research scientists, NGOs officials, religious leaders and field extension officers, who have different stakes in the field of climate change. Data triangulation was adopted in order to maintain the clarity of the research results, in which all interviews with experts, research scientists, and religious leaders were compared and cross-checked with household surveys and records for interviews and focus group discussions. 'Theoretical triangulation' refers to the process of using multiple theoretical perspectives to study the same phenomenon. This was adopted in this study from the beginning of the research and data interpretation process. The use of different theoretical concepts allows for this research to be viewed with multiple lenses, and broadens the understanding of the research problem. 'Analysis triangulation' refers to the multiple methods of data analysis that were used to analyze the qualitative data. This was done to ensure the validity and comprehensiveness of the research (Hussein, 2009). 'Researcher-triangulation', refers to the involvement of more than one researcher, observer or data analyst in the same study for research confirmation purposes (Denzin, 1989). The observations and interviews personally conducted by the researcher in Muleba and Missenyi Districts were complemented by, surveys carried out by research assistants. Finally, 'methodological triangulation' entails the use of more than one methods of data collection in studying a phenomenon under investigation. The use of multiple data collection methods allows for more detailed and multi-layered information to be gathered (see Kopinak, 1999). In this study, semi-structured and in-depth interviews with local community members,

(mainly farmers and livestock keepers) were combined with participatory research tools, while complementary information was collected through a structured survey.

### 3.2 Choice and justification of the study area

This study was conducted in two districts: Muleba and Missenyi. The reasons for choosing these districts as study area are threefold. Firstly, the study areas are increasingly encroached by economic and socio-cultural transformations, which are changing the Haya traditional way of living hence threatens existence of indigenous knowledge within the community. This study therefore, aims to shed light on the current circumstances regarding the use of indigenous knowledge in adapting to vulnerability and climate change risks. This study also seeks to delve into how on-going economic and socio-cultural changes have undermined the capacity of the Haya to utilize indigenous knowledge for reducing vulnerabilities and climate change risks (cf. 5.1). Secondly, the study areas are among the early settlements of European settlers who colonized Tanganyika (Tanzania Mainland) from 1885-1918 (German colonialists) and from 1945-1961 (British colonialists). The earliest colonialists to settle in the study areas were the missionaries who grew coffee, banana, sweet potatoes and cassava on their farms. This has caused the area to be exposed to modern farming for more than 80 years. This historical context allows for an opportunity to evaluate the development of indigenous knowledge alongside the influence of Western knowledge that was applied by the colonists in their farming and livestock keeping activities. It is hypothesized that local community members might have worked on these farms, and that they might have adopted some of the Western knowledge and technology on agricultural and livestock keeping activities. The adoption of this Western knowledge could have a substantial influence on the development of indigenous knowledge in this area. The influence of Western knowledge and technology on indigenous knowledge may have resulted in the creation of hybridized knowledge which would add a very interesting dimension to the research on the development of indigenous knowledge.

Tanzania is currently in the process of implementing different agricultural development programs such as, the Agricultural Sector Development Programme (ASDP) and the District Agricultural Sector Investment Project (DASIP). ASDP is implemented in 132 rural districts in Tanzania Mainland where 90% of the population are living below one dollar per day (IFAD, 2007). The focus of these programs is to promote modern farming practices in order to increase harvests and therefore increase exports of crops and ensure self-sufficiency in food production (Orr *et al,* 2000; Peters, 2002). Significant efforts have been undertaken by

the government to employ and train Agricultural and Livestock Field Extension Officers of high calibre. These experts promote modern farming techniques at the local level in order to fulfil the government's goals of food self-sufficiency and surpluses for export. Both the Missenyi and Muleba districts are well supplied with field extension staff members for the improvement of agriculture and livestock management. The existence of agricultural and livestock experts within the study area is considered a vital factor in the dissemination of modern technology within local communities. These experts are responsible for disseminating and facilitating the adoption of modern farming and livestock keeping practices within the community. To this end, it was imperative to assess the extent that local communities were applying indigenous knowledge at the local level in defiance of the recommendations made by extension staff members and experts in favour of Western knowledge (cf. 8.1).

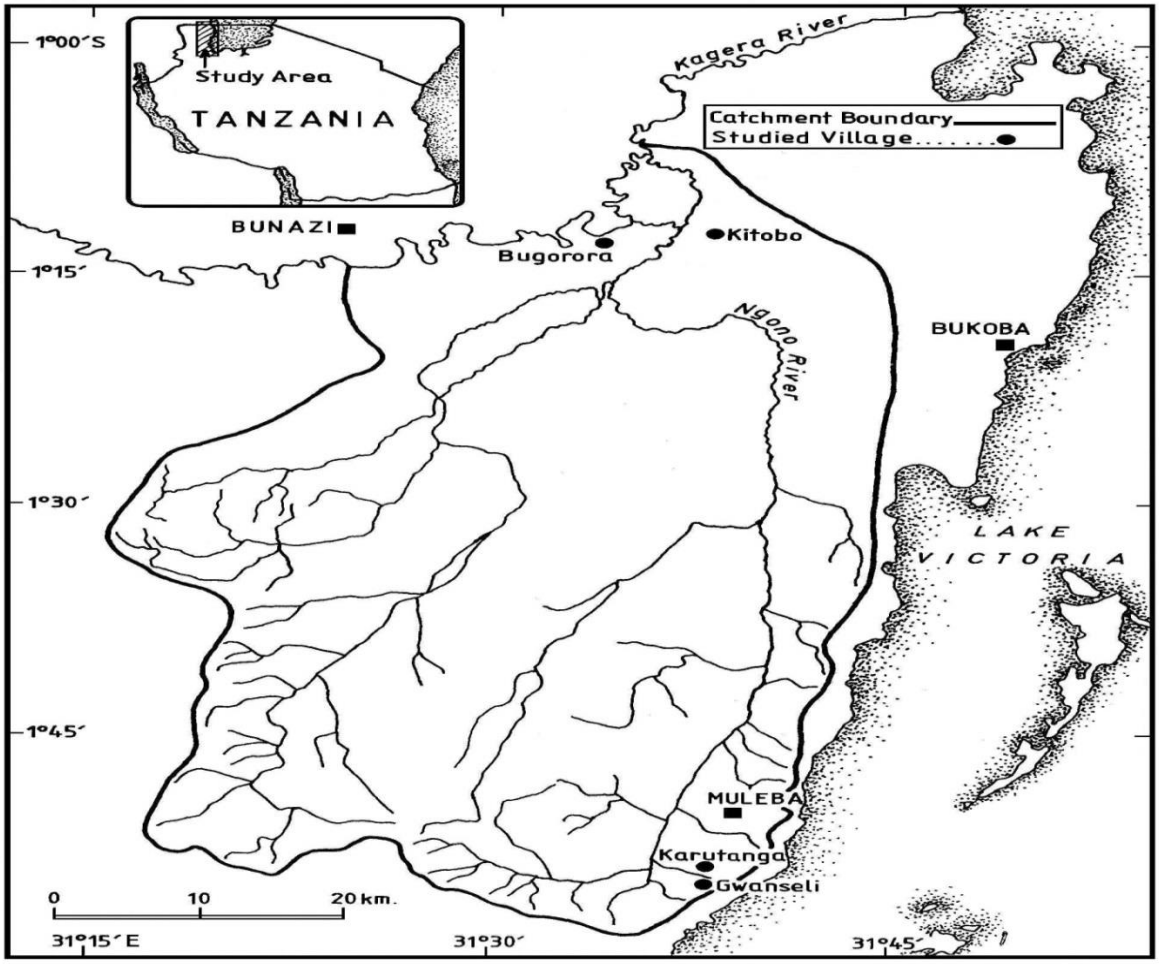


**Figure 4: Map of the study area indicating the wards selected for this study**

***Source*****:** *URT (1994)*

### 3.3 Selection of the study villages and unit of analysis

Since the study focus was on those villages situated in the Ngono River Basin, I had to select six villages from three wards which are the Magata-Karutanga (Muleba District), Bugorora and Kitobo Wards (Missenyi District). The choice of villages was influenced by their proximity and attachment to the Ngono River Basin. Physical proximity was important because the people who live in the basin would therefore be the most knowledgeable about climate change in the basin. The selected villages also reflected a diverse range of agro-ecological zones in the upland and lowland areas of Ngono River Basin. Thus, Magata, Katanga and Karutanga villages were selected from Muleba District, and Bugorora, Kabingo and Mbale villages were selected from Missenyi District.

The selection of the study area and topic was in fact undertaken before the start of my PhD studies at the University of Bonn in 2013. Having been raised within the study area of Muleba and Missenyi Districts, I had come to understand that both districts were among the most vulnerable districts to climate change risks in Tanzania, and had experienced serious climate variability as well as incidences of Banana Xanthomonas Wilt (BXW) or (*mnyauko* in the Haya language) disease in recent years. This disease has seriously affected agricultural production of bananas the dominant staple food in the study area. I also came to understand that one of the major contributors to the climate change risks in the area is severe environmental degradation by local communities, and it was my own conviction that something needed to be done to strengthen the adaptation capacities of the local communities. A long spell of dry seasons in the year 1997, and the El Niño rains of 1998, caused serious impacts on the livelihoods of the study villages. This period is considered one of the most important periods in the study area as it marks the beginning of the worst decrease in agricultural production in 30 years. It was during this period that all the serious climates related risks were initially felt.

However, it was not easy to generalize about the impact of climate change on local community's livelihoods across the Kagera Region, because the conditions and problems of climate change tend to be very location specific. Zoomers (1999) argues that while analyzing a local community's livelihood the structural components must also be considered. She argues that these components such as the geographical context, the rural or urban nature of an area, agro-ecological zones, demographic structure, and distance to markets usually affect the set of opportunities and outcomes of the actor (p.1). For instance, the impact of the 1997 drought and 1998 El Niño was not the same in all areas in the Kagera Region. Based on this fact, I selected six contrasting villages with varying social environments and agro-ecological zones, three in the south (Magata, Katanga and Karautanga) and three in the north (Bugorora, Kabingo and Mbale) of the Ngono River Basin. The six selected villages were not only hit hardest by climate change risks, but were among the villages undertaking a special campaign to combat BXW disease initiated by the District Commissioner (DC) offices in the respective districts. This campaign relied field extension staff to create and spread awareness about the disease within areas of their jurisdiction at the time of the study, the awareness campaign had been running for almost two years.

### 3.4 Sample size and sampling techniques

Determining sample size is a crucial issue because samples that are too large may waste time, resources and money, while samples that are too small may lead to inaccurate results. In many cases, we can easily determine the minimum sample size needed to estimate a process parameter, by using the population mean $\mu$ . In this case, the population mean was calculated from the total population of Kagera Region divided by the number of districts available in this region:

**Solution**

Mean = Total Population/Number of districts

Mean = 2,458,023/8

Mean = 307252.9

The population standard deviation was calculated from official census statistics from the Kagera region as:

Standard deviation = 118711.4

With the standard deviation, we can now obtain the required minimum sample size for a specified confidence level and margin of error. The following formula can be used since we knew $\sigma$ and wanted to determine the sample size necessary to establish a confidence level of $1-\alpha$, with the mean value $\mu$ to within $\pm E$.

$$n = \left[\frac{z_{\alpha/2}\sigma}{E}\right]^2$$

Whereby n represents – Sample Size

$\sigma$ represents – Standard Deviation

Z value represents - 1.96, a 95 % confidence interval

E represents – margin of error, in this case an arbitrary value is 340

n = (((118711.4*1.96)/340)*2)/ 4.7 =291

Note: 4.7 is the average household size in Kagera region

Therefore, the required sample size is 291 households

To select the households in the villages, random selection was employed to obtain a sample for the questionnaires. This was accomplished by using the village household register book with the assistance of the village leaders. A total of 291 households from all six villages were selected into the sample for the questionnaire: 49 households from Magata, 56 households from Katanga, 48 households from Karutanga, 53 households from Bugorora, 42 households from Kabingo, and 43 households from Mbale. In Magata, Katanga and Karutanga villages, every 12$^{th}$ household on village register was incorporated into the sample. In Bugorora every 10$^{th}$ household was selected, while in Kabingo and Mbale, every 7$^{th}$ household was selected. All of the heads from the selected households turned up and filled out the questionnaires for this study. For the focus group discussions, the selection for interviewees was guided by the Village Executive Officers (VEOs) of the respective villages in order to identify the right villagers to be involved in the discussion. The selection of interviewees also took the roles and experiences of the village members into consideration. Village leaders were consulted to identify elders to be interviewed in each of the villages. A total of 18 focus group discussions and 48 interviews were conducted in this study. The issues discussed during the interviews and focus groups were related to historical perspectives of their areas, different on-going changes as observed by the local communities, as well various long-term adaptation practices for enhanced adaptive capacity.

*Sampling of government staff and NGOs*

Meetings with the District Administrative Secretary (DAS) in both the Muleba and Missenyi districts were arranged in advance and used to identify the heads of the departments of Agriculture, Livestock and Environment, and Natural Resources. Those heads were used to identify six key people who were working in respective villages as extension staff. These people were identified and selected, along with two retired extension staff members who had worked in the area and were identified through the local communities and other government officials. The interviews with these two was important in order to learn more about the historical context of agricultural and livestock keeping practices in the study area, and the way local communities adapted to different climate change risks which affected their livelihood activities. The same approach was used to identify and select different NGOs, which were actively working in the study area. Two NGOs dealing with agricultural production were identified and selected for this study. These NGOs had different

development programs that focused on improving the lives of rural poor community in the study area.

### 3.5 Data collection methods

This study was designed to use both qualitative and quantitative methods (mixed design). Both primary and secondary data was successfully collected in this study. Qualitative data was collected through Participatory Rural Appraisals (PRA), focus group discussions, and interviews. Quantitative data were collected through the use of household questionnaire. Interviewees were asked similar questions in different settings which was aimed at reducing the likelihood of a biased interpretation of their responses. The data collection and analysis process is described below.

#### 3.5.1 Primary data: qualitative research methods

A qualitative research approach is mainly characterized by narrative analysis, concentrating on the connotations that actions have for certain people (Hulme, 2007, p.6). This research approach is important for explaining a complex phenomenon that is located and entrenched in a local context (Alemu, 2013). This approach was useful to this study as it enabled the research to delve into how the local community adapts to climate change using indigenous knowledge. During the empirical fieldwork, I came to realize that qualitative approaches were ideal for the local conditions, environments, and different stakeholders in this study. However, in case of any changes which occurred during the period of study, this approach was flexible and allowed shifts in the original focus of the study to integrate new realities in the field (see Johnson and Onwuegbuzie, 2004). The qualitative data for this study was gathered using participant observation and PRA (resource mapping, transect walks, interviews and focus group discussion) methods. This approach provided with me an understanding and description of the local community's experiences regarding their changing environment.

The qualitative approach has a myriad of benefits as broadly discussed in literature. Griffins mentions the following advantages of qualitative approaches: that it increases the degree of flexibility in research design, it has the ability to avoid a dependence on the researcher's pre-determined assumptions, and it has the ability to focus on the meaning of important issues for participants, especially any illogicality or discrepancies in their perspectives. Qualitative approaches can enable a researcher to solve sensitive issues, to appreciate the broader social context of a certain community's experience, and to make connections across various

localities of participants' lives (Griffin, 2004, p.3). However, qualitative approaches allows a researcher to observe behaviour and conditions in a natural setting; it usually treats the researcher as the primary tool for gathering data and on descriptions since the phenomenon is captured through words, pictures and other media. It is concerned with meaning (i.e. the way people make sense of their daily living, and experiences) and is inductive in nature (i.e. researcher usually builds abstractions, concepts, hypotheses and theories from facts observed) (Creswell, 1994).

However, Griffin (2004) has underscored different weaknesses of the qualitative approach, as it creates ambiguities when applied. This approach runs the risks of being expensive and time consuming during data collection and analysis, it depends on a relatively small number of respondents, and the results might be influenced by a researchers' personal prejudice and peculiarities. In order to overcome these limitations this study adopted the between-method triangulation technique (see Hussein, 2009), and the quantitative approach was used alongside qualitative approach to offset its potential weaknesses.

*Participant observations*

Participant observation is the data collection method that allows a researcher to learn about different activities of a certain community under investigation by observing and participating in those activities (Kawulich, 2005). Participant observation provides researchers with a means to check for nonverbal expressions of feelings, to see how different people interact and communicate, as well as to see how much time is spent on different activities (Schmuck, 1997, p.50). This method allows researchers to investigate local terms and phrases that respondents use in interviews or observe events that respondents may be unwilling or unable to share. Respondents in interviews may also give a researcher what they think they want to hear, rather than the truth (Peters, 2002; Tembo, 2003). Since participant observation allows a researcher to observe the practices in person, the problems of deliberate and unintended distortion from respondents can be avoided.

As the lead researcher I participated in different farming and livestock keeping activities in the study area. Throughout the course of field observations, I grazed livestock (*okulisa*), prepared ridges for Bambara nuts (*enshoro*), cleaned banana farms (*okushalila*), sowed beans and maize (*okubyala*), weeded (*okubagala*) and harvested crops with local communities. The Information collected with this method includes how farmers handle and manage crops, care

for banana farms, deal with pests, and control diseases for both crops and livestock. This method assisted me in establishing a good rapport with local communities and farmers.

*Expert interviews*

The expert interviews were used to collect information from government extension staff, and NGOs experts. Interviews with extension staff helped me to collect valuable information about the way extension staff disseminates western knowledge to local farmers. These information were collected during different meetings and field visits. Visits to farms demonstrating new technologies for banana planting and pest management, were made by the researcher to observe the modern technologies being promoted and disseminated to local communities in the study area. Data was collected about the official recommendations on the type of knowledge suitable for farming and livestock activities, breed selection for crop and livestock, the planting dates, weeding period, and general farming and livestock practices that were considered appropriate for the study area.

I was able to understand different extension services provided within the community and their modes of delivery. Two retired extension workers were interviewed and provided information about their past experience with indigenous knowledge and the current status of its application in farming and livestock management especially with communities adapting to climate change risks. This was imperative as the modernization programs that were established in the study area by different government agricultural programs were considered to have affected the indigenous knowledge acquisition and generation.

For the NGOs, such as the Missenyi Aids and Poverty Eradication Crusade (MAPEC) and Maendeleo ya Wakulima (MAYAWA), open-ended questions were prepared in order to generate information regarding their objectives in the study area. These NGOs had different on-going programs implemented in the study area but this study only focused on the agriculture, livestock keeping and environment related programs. Different information was gathered from these NGOs about the type of advice they were giving to farmers on farming and livestock keeping practices. It was imperative to collect information on the objectives of the programs and the way they were being carried out in the field because such kinds of activities are a source of knowledge for local communities in the study area. Organizing interviews with NGOs representatives was easy because all NGOs' offices were located in the study area. Interviews with representatives of NGOs gave me insights regarding different environmental, agriculture and livestock development programs implemented in the study

area. The study managed to delve into the impacts of these programs regarding the sustainable use of indigenous knowledge by local communities in recent years.

*Participatory rural appraisal*

Participatory Rural Appraisal (PRA) is a popular technique of data collection in rural areas. It involves a considerable paradigm shift from 'top-down' to 'bottom-up' approaches, and from the 'blueprint' process to the 'learning' process. Moreover, PRA represents a shift from extractive survey questionnaires to knowledge shared by local people. It is grounded on village experiences where local communities effectively manage their own natural resources (Cavestro, 2003, p.3). With the PRA method, it is possible to learn the life and the environment of rural people. This approach requires a researcher to act as a facilitator to assist local people in undertaking their own situational analysis, plans and actions accordingly. It is centred on the principle that local people are creative are able to participate in their own study and analysis. Chambers defined PRA as methods of learning that concern rural life and conditions, from, with and by rural communities. He further specified that PRA extends into analysis, planning, and action. Usually, it integrates villagers and local officials during the process (Chambers, 1992).

PRA originated in the early 1990s, evolved and driving its basic principles from numerous sources and traditions including activist participatory research, agro-ecosystem analysis, applied anthropology, field research on farming systems and Rapid Rural Appraisal (RRA) (Uddin and Anjuman, 2013, p.72). Alam and Ishan (2012) explicated that PRA is the most appropriate method to identify the existing conditions of a rural community. Thus, it was a suitable method to apply in this study as it closely involves local communities in identifying different on-going changes, particularly climate related events.

Given the socio-cultural context of the Haya, very little was known regarding their perceptions of different on-going changes, particularly climate change, or how they are adapting to this situation. It was evident that the best source of information regarding these issues would be local communities themselves. The PRA was used for data collection in order to get relevant information that could only be optimally achieved by observing and recording different on-going changes, particularly climate change and specific local adaptation strategies. This study used a combination of PRA techniques such as transect walks, resource mapping, history timeline, interviews, and focus group discussions. These techniques enabled local communities to participate fully by sharing, enhancing and

analysing their knowledge of life, as well as to monitor and evaluate different on-going situations. I surrendered the authority to local communities to do their own analysis, plan and taking action. The only role I had during PRA process was to facilitate the exercise.

The motive behind the use of PRA was to gather data that could show the day to day activities of the Haya community where the research participants collected their own data with minimal assistance from the researcher. When local communities are involved in the day to day of their farming and livestock keeping activities, they usually take responsibility, become proactive and fully accountable. This also improves their self-confidence and independence and, in the long run, enables the local community to reach their full potential (Walt and Rifkin, 1990). In this study, the use the PRA approach simplified the data collection process as the information was collected by using simple methods such as talking to people, walking around the community, and observing.

There are several tools and techniques of PRA, these tools are described below and their involvement in this study is explained.

*Transect walks*

Transect walks are community tours undertaken by researchers using community guides who best understand their village and represents various group within the community (Mahiri, 1998). During this walk, important social and physical features of the region are recorded (Uddin and Anjuman, 2013). In this study, transect walks involved diagonal walks across the study villages, and I was able to observe, discuss, and ask open-ended questions, to the villagers. This approach was useful to this study as it helped the researcher to gain the trust of the local community. It was also helpful to identify conditions under which climate change may have significant impacts in a village. Transect walks were combined with field observation in assessing the magnitude of crop damage, particularly from BXW disease and other crop pests and diseases within a farm or *kibanja*. Permission from individual farmers to visit their *bibanja* was sought in advance. This authorization came after I had explained to them the purpose of the transect walk across their farms and *bibanja*. The visits were conducted when farmers were in their *bibanja* or other farming fields. However, transect walks also helped the researcher to observe other livelihood activities, which were established as alternative sources of income after the decrease of banana and coffee production. Some of the activities observed were fish farming in, brick making, local alcohol making, stonemasonry, and small businesses. While undertaking transects walks, the

researcher used community guides to establish the boundaries of the villages. Local farmers were asked to show the researcher the boundaries of their *bibanja* and farms before starting a transect walk. Local communities were then asked questions regarding the findings of the transect walks to give information on farm management practices.

Transect walks were easily carried out while the owners of the *bibanja* and farms were available. The accompaniment of the *bibanja* owners during transect walks was helpful since it allowed for discussion and further probing on issues related to field observations, which contributed to the positive attitudes of the respondents (see Lado, 2004). Generally, transect walks covered distances of about six kilometers per day. The walks were conducted during the planting period and were thus, used to confirm the specific planting dates of various seasonal crops. After the initial rains fell in August, the researcher had to visit the farms to record the planting dates of crops, especially seasonal crops such as maize, beans, groundnuts and Bambara nuts.

*Resource mapping*

Village resource mapping is the visual compilation of the available resources in a given community. They are usually drawn by local communities on the large pieces of paper or on the ground to show spatial representations of resources such as water sources, agro-ecological zones, agricultural landscapes, as well as grazing and forests area (AFN, 2002). This mapping also focuses on depicting the habitation patterns and nature of housing in a certain community. Resource maps differ from other regular maps as they are made by the local communities themselves and not by experts. It allows local communities to depict only what is important to them. Local communities are considered to have broad knowledge of the surroundings where they have lived for many years. Thus, the resource map drawn by the local communities is considered to be detailed and accurate (Kumar, 2002).

In some of the villages, local communities were able to draw two resource maps; one map indicating the past level of natural resources in the village, and the other map indicated the present level of available natural resources in their villages. These maps reflected the local community's perceptions on their changing environment. Mapping was followed by intensive discussion on the present situation regarding natural resources in their village, in which the problems and impacts of on-going environmental changes were brought up. Many local communities were of the opinion that the decreases in both rains and agriculture production were the two leading problems. Though awareness creation on conserving the environment

by stopping deforestation had been taken up, the measure was not effective in arresting the decrease of rains. The indigenous knowledge on rain making, which had helped them to bring the rain in the past, had become dysfunctional in the present era due to the decrease of rain maker experts and reluctance of the younger generation to pick up this knowledge. Accordingly, resource mapping helped the local communities to realize that the increase of environmental degradation and neglect of indigenous knowledge had led to recent decrease of rains in their villages.


**Figure 5: Local communities drawing a resource map at Katanga Village**

***Source*:** *Fieldwork (2014)*

*Semi structured interviews*

To have a general overview of the historical context of climate change events, community interpretation of climate change risks, and the types of adaptation measures, forty eight individual farmers and livestock keepers were selected and interviewed in-depth. Those interviews were organized in informal semi-structured interviews with guiding topics and open-ended questions. Semi-structured interviewing gives room for the respondents to correct or criticize the questions and respond in any way they wish since everything is negotiable

(Mikkelsen, 2005). I prepared a checklist of questions (Annex 2) and all questions were asked following this guide. Forty days of intensive interviews in the study area (twenty two days for Muleba and eighteen days for Missenyi) helped me to obtain a great deal of information. Besides, those interviews were helpful to my study as they assisted me in obtaining qualitative information that enriched the quantitative surveys. I was able to clarify certain issues regarding the questionnaires that needed more elaboration. All the data was cross checked by interviewing multiple respondents on the same topic.

The main challenge that I experienced during the interviews was that it was difficult for some of the respondents to understand the questions I asked. They would often start by explaining many things which seemed to be off-topic. This was a great challenge to me as I had to strive and make more clarifications so as to make them understand the questions. However, during the interview process, I came to realize that some of the respondents were not telling the truth. In such circumstances, I would challenge the answer he or she had given me in order to get a more truthful answer. At the end of every interview session, I would ask the respondent if he/she had anything they wanted to add. This gave me the opportunity to revisit some issues which required clarifications from the respondent.

There were some unique challenges with particular respondents. One of the interviewees, an old man (*omugurusi*) aged 83 years old living in Katanga Village had particularly detailed information regarding indigenous knowledge-based practices on agriculture and livestock keeping activities. Unfortunately, this old man could not speak fluent Swahili; thus, I had to conduct my interview using the Haya local language. I spent almost the whole day talking to him as he was speaking slowly.

**Figure 6: Interviews with some local communities in the study villages**

***Source*:** *Fieldwork (2014)*

*Focus group discussions*

The focus group discussions in this study were conducted with men, women and youth (working age group) separated into different groups using a pre-prepared focus group questionnaire to guide the discussions (Annex 2). Focus groups can produce useful information and insights that would be less accessible in the absence of the interactions found in a group setting (see Landlof and Taylor, 2002). This approach also "provides direct evidence about similarities and differences in the participants opinions and experiences as opposed to reaching such conclusion from *post hoc* analyses of separate statements from each interview" (Morgan, 1997, p.292). Eighteen focus groups at the six 6 selected villages were conducted at different stages of this study in order to gain insights and critical information from the community. Focus groups were used to confirm research findings that were generated using other approaches. The focus groups used in this study were arranged with groups of farmers and livestock keepers, and were not based on random sampling as the respondents were purposely selected. The respondents were selected based on their experience in farming and livestock keeping activities. For the youth, the criteria were based on age preferably starting from 18 to 35 years. This age group was assumed by the researcher as working age group, and they were participating fully in farming and livestock keeping activities. The decision to include youth in the focus groups was driven by the fact that many

elders within the community blamed youth for being reluctant to use indigenous knowledge in their farming and livestock activities. Thus, youth involvements in focus groups were of great significant in getting their opinion regarding these allegations over the use of indigenous knowledge.

Before the start of each focus group session, I would inform the respondents about the topics that were to be discussed, which would include: their daily experiences and perceptions of different on-going changes, causes and triggers of those identified changes, identifying different adaptation strategies to withstand these changes, knowledge transfer from parents to their children, and the challenges of applying indigenous knowledge to adapt to these changes particularly climate change. In these discussions, I would act as a facilitator and keep a record of the discussions. Since taking written notes of the discussions was quite difficult, I had to use a voice recorder to capture information that I was unable to record in my notes. Beforehand, I would ask permission from the respondents to record their voice by assuring them that the recorded voice would be used for research purposes only. Some of the focus groups were conducted in *Swahili* language while others were conducted in the local Haya language. This improved the level of participation for those who did not understand *Swahili*.

Focus group discussion is an effective method of data collection, but in this study, this approach was not free of challenges. It was difficult to get the required minimum number of the respondents at the same time for a meeting. As emphasized by Bernard (1988) that focus group discussion should ideally have between six and thirty respondents. Most of the local communities were busy with the preparations of their farms for planting, while others especially women were sowing beans and maize. Thus I had to organize the focus group discussion either early in the morning before local communities had left for farming activities or during the afternoon when they return home for lunch.

### 3.5.2 Primary data: quantitative research methods

Quantitative approaches refer to methods of collecting numerical data, making measurements and observations of a phenomena which can be subjected to statistical analysis, repeated and simulated by other researchers under the same conditions (Hancock, 2002). The data collection and analysis process takes relatively less time compared with qualitative approaches. In this study, the results generated from the sample surveys gave a clear picture of the causes and impacts of climate change within the community. I found that the results from the quantitative approaches could be easily aggregated and compared across the region

and the country at large. However one the weakness of the quantitative approach is that the knowledge generated might be too abstract and general for direct application to specific local conditions and contexts. Moreover, opting to use the quantitative approach requires a large investment in enumerators and teaching them how to carry out data collection. Poorly trained enumerators may make mistakes and unintentionally influence responses (Hulme, 2007).

*Questionnaire survey*

The questionnaire surveys were conducted from August to October 2014, and were used to obtain contextual and demographic data about the respondents, including the respondent's: age, education status, gender, level of income, household's farm size, household members, etc (Annex 1). The questionnaire had both closed and open-ended questions. The heads of the households were required to provide detailed information including the size of their farms, the type of crops that they grow, as well as the varieties and numbers of livestock kept by the households. Information about crop types and farm size were important in determining their labour requirements, and showing whether they were oriented towards either market or household consumption. Other information related to their perceptions of the status of local climate, causes and impacts of climate change were also collected using this technique. However, local communities were requested to mention the sources of knowledge that they used as the basis for their adaptation to climate related risks, and the following options were given to them to choose from: Farmer's experiences, Field extension staff members, NGOs staffs, Research, Village leaders, Neighbours, Parents, Relatives, Medias and Any other/specify. This list showed how knowledge is being produced and learned within the community itself.

### 3.5.3 Secondary data: documentary review

Documentary review involves a detailed literature review of both published and unpublished works in order to have a broader understanding of the research topic. Mikkelsen (1995, p.74) emphasized that "no matter what your research topic is there is almost always a wealth of information hidden in a variety of sources". In this study project, published and unpublished works related to history of the Haya people, climate related issues, and indigenous knowledge on climate change adaptation were reviewed. Additionally, a detailed review of relevant government documents on the National Climate Change Strategy was undertaken. Information obtained from documentary review was used to build the conceptual and theoretical underpinning of this study. Official demographic statistics were obtained from the

Kagera Regional Statistics Office. Information regarding the different agricultural programs in the study area was collected from the Ward Executive Officers and NGOs.

### 3.6 Analysis: Qualitative and quantitative data analysis

The analysis of qualitative data began right from the field and was facilitated by the respondents themselves. Different emerging themes were discussed and evaluated with the respondents. After the evaluation, new themes could be identified and reinvestigated. The work was edited at different stages while still in the field. The decision to edit each interview was helpful to me as I was able to get back to the respondents and get clarification on missing information. After the completion of the data collection exercise, all recorded interviews were transcribed using f4 audio transcription software. After transcriptions, all interviews were translated from *Swahili* and Haya languages to English and entered into word-documents. Unrecorded interviews were edited first and then copied into a word-document. Thereafter, all of these documents were analysed using Atlas.ti software, which used for analysing qualitative information from large bodies of textual, graphical, audio as well as video data.

All word-documents were entered into a database and subjected to a rigorous analysis using Atlas.ti. With the help of Atlas.ti, I first created a primary document family, in which all interviews were categorized into their respective groups for example, field extension staff, government officers, farmers/livestock keepers, and research scientists. After this, all the texts were assigned codes. Thereafter, code categories were created by merging different codes to form themes or patterns. Finally, all the categories and themes were assessed and filtered in terms of their utility in responding to the research questions.

Dealing with quantitative data proved to be easier and more straightforward than analysing qualitative data. The quantitative data collected from the questionnaire surveys were also entered into a database and subjected to statistical analysis with the help of SPSS (Statistical Package for Social Science). This software was helpful in generating simple descriptive statistics, such as frequencies, percentages and cross-tabulations. The statistics depicted level of awareness about climate change, causes and impacts of climate change, as well as sources of indigenous knowledge to local communities.

### 3.7 Chapter summary

This chapter has presented the methodological approaches used in this study. Basing on the nature of this study, it was clear that the results of this study couldn’t be obtained by using a single approach. Combinations of different approaches were needed, in which the strengths of

one approach offsets the weaknesses of the other approach. The use MMR in the form of triangulation was helpful in obtaining different types of information on the same issue. It was also crucial in ensuring the validity and reliability of the results of the study. The data collection process regarding the role of indigenous knowledge on climate change adaptation in the Ngono River Basin required a high level of trust between the researcher and the respondents. In order to achieve this trust, I conducted informal discussions with the local community members and leaders during my earlier preliminary survey of the study area, which was used to establish a good rapport with the community. I was able to identify village leaders who guided me during transect walks around the village which also increased the trust of the local communities. The method of asking various people the same question helped to increase the reliability of the data that was collected. The open-ended questions that were used in the interviews were important in obtaining a deep and clear understanding of how local communities experience, and adapt to vulnerability and climate change related risks using indigenous knowledge.

# Chapter Four

## The Regional Setting: Historical Context, Physical Characteristics and Environmental Profile

This chapter establishes the context of the region where this study was conducted. The chapter comprises of three sections. Section one provides an overview of the historical background of the Haya people inhabiting the Ngono River Basin of the Kagera region. This will provide an overview of the Haya people based on their socio-historical context. This section is built on information that comes from an extensive review of previous studies conducted in the study area. Section two gives a general description of the study area, including a description of physical characteristics such as lakes, rivers, plateaus and wetlands in the Kagera Region. Moreover, climatic conditions and seasons, which determine the temperature and rainfall status of the study area, are explained. Specific information is provided on the population increase of the Haya people because it has profound implications on the environmental resources available in the study area. Section three presents the resource maps of two villages (Katanga and Bugorora). These maps were generated by local communities themselves to indicate the different environmental resources available as well as the different land use patterns of their villages.

### 4.1 Brief historical context of the Haya

Since the present study was undertaken in an area inhabited by the Haya people, it is of paramount relevance to have a general historical overview of the Haya so as to better understand them. The Haya people are famously known as one of the Bantu speaking communities[6] living in the North-western part of Tanzania, Kagera region. They are easily identified by most anthropologists as one among the interlacustrine groups known as the western lacustrine Bantu of Lake Victoria (Niwagira, 1991). Although there are other ethnic groups living in this region, such as the Zinza, Nyambo, Subi and Angaza people, the Haya

[6] According to Katoke (1975), Bantu people are believed to have migrated to North-western part of Tanzania either between 2500 BC or between the 5th and 10th AD. Other scholars like Kahakwa (2003) argues that this group migrated from the Cameroon and Niger highlands along the Niger-Congo Rivers. Based on these historical origins, Kahakwa (2003) points out that Bantu speakers within the interlacustrine region have been roughly categorized into two linguistic and cultural groups: the easterners which includes the Soga, Ganda, Gume people and the westerners which includes the Toro, Nyoro, Kiga, Nyankore people, in Uganda as well as the Haya and Zinza people of Tanzania. In Africa, the Bantu-speaking community makes up a major part of the population in nearly all African countries south of the Sahara. They form over 300 groups; each group has its language or dialect. These groups vary in population from a few hundred to several million (Van Lehman, and Eno, 2003 p, 1).

people are the majority (Kalikawe, 2003). The name Haya was originally given to the fishermen inhabiting the shores of Lake Victoria and the word was used as a minor insult in pre-European times. A fisherman was called *Muhaya*[7], because the fishermen were considered to be a class without real property (Cory, 1959). The language of the Haya is *Kihaya*, a language among the Bantu family language that entails a number of vernaculars, including *Edangabo, Bumbira, Ganda-Kiaka, Hangiro, Hamba, Mwani, Ekiziba, Nyakisisa and Yoza*, which are spoken by several Haya subcultures. According to the recent Tanzania National Census (2012), the population of the Haya ethnic tribes is estimated to be over 1,300,000, making up approximate 2.7 % of the entire population of Tanzania (URT, 2012).

Based on their geographic location, there have been historical interactions between the Haya people and their neighbour communities in Uganda. This interaction was crucial in terms of trade, intermarriages and religion sharing (Cory, 1959). Accordingly, different scholars have identified Uganda as the point of origin of the Haya people (see Kilaini, 1990; Mutembei, 1993; Kibira, 1974). These scholars assert that the Haya people are the result of intermarriage between the Bantu speaking people of Uganda, particularly the *Baganda*, *Bahima*, *Batoro* and *Banyoro*. These Bantu people split and migrated southwards and forming the Haya ethnic tribe. They migrated to escape the conflicts, which existed in the western part of Uganda. Currently, they inhabit the shores of Lake Victoria in Bukoba District, Bukoba Municipal council, as well as Missenyi and Muleba Districts of the Kagera Region in the northwest of Tanzania (Effiong, 2009). The historical record shows that, the *Hayaland*[8] alone comprised of seven Chiefdoms namely; Kiamutwara, Ihangiro, Kiziba, Bugabo, Kihanja, Missenyi and Maruku. These Chiefdoms are recognizable in the current day. The regimes of these Chiefdoms were invaded by the Germans who had colonized Tanganyika in 1890s, and tater, the British colonialists took over from the Germans after the First World War ( *ibid*).

The *Hayaland* was used as a transit zone by many different traders before colonialism. Most notably the Arabs trading in ivory, gold and slaves between the Congo and Uganda used *Hayaland* as a transit zone. This fostered robust trade centres such as *Kamachumu, Katoro, Kyaka and Muhutwe*, which remain important trading centres in the area. Missionaries and explorers settled in the *Hayaland* because of its beautiful climate and fertile evergreen

[7] Muhaya represents a single person among the Haya tribe.

[8] The *Hayaland* is the area inhabited to great extent by Haya people in Kagera region, and according to information provided by Kagera Regional Secretariat, Haya people are mostly found in Muleba district, Bukoba district, Missenyi District and Bukoba Municipal council (see figure 4.1 map)

environment overlooking Lake Victoria. This European settlement influenced development in the *Hayaland* and the whole region at large with religious, education and health facilities being set up throughout the area (Kalikawe, 2003*)*. The area is considered to be the first areas where Roman Catholic and Lutheran missionaries settled in Africa. Currently, both denominations have many followers within the region as evidenced by the multitude of impressive cathedrals and churches found in the area (Kameli, 2007).

In the past the Haya people were divided into two groups namely: "*the Bairu*" who were well known for their banana farming and; "*the Bahima*" who were famous for pastoral activities. During the pre-colonial era, the Haya indigenous communities had their own local chiefs known as "*Omukama*". These local chiefs emanated from a few specific clans called *"Barangira"*, which produced local rulers. These clans consisted of the sub-clans: *Wabito, Bahinda* and *Wankango* (Effiong, 2009). The traditional belief systems of these clans are still based on tribal totems and on many deities known as *Abachwezi*. Every clan is named after its founder and each has its own set of taboos. For example, some clans are not allowed to eat a certain type of food or meat, which seems to be clan totem (*omuziro*). Each clan also has a special animal as a tribal emblem locally known as *"ekyerumuno"* (Kashaga, 2013, p.34). A good account of the clan totem was given by the chairman of *Abasimba* clan during the interview in Bugorora Village:

> …..our secondary totem of the Basimba clan is the dog. It is believed that the old man (*Omugurusi*) of this clan who was also initiator of the clan, when he was born, also the same day the dog of the house had puppies. Several times that dog used to clean the child by licking it. *Omugurusi* later out of gratitude ordered his descendants to consider and value dog as their friend and hence dog became our secondary totem of our clan[9].

Further, Cory (1959) states that the Haya people had two major categories of totems, secondary and primary totems which are looked upon in entirely different light. The primary totem is the real taboo because it may not be killed, touched, eaten and in some cases even looked upon. Conversely, the secondary totem is perceived to be more friendly and often explained by the people as the brother of the clan. For example, the secondary totem of the clan *Barwani* (many) is lightning, and any *Murwani* (individual) believe lightning to be his or her brother, it would never harm them.

[9] Interview with chairman of Abasimba Clan in Karutanga Village, 23rd September 2015 (Own translation)

There are also strictly defined social expectations. In Haya communities, aunts and mothers teach their young girls about domestic chores and how to become good housewives, which is an expectation by the time they reach marriage age. Marriage is strictly prohibited between members of the same clan, a measure which also extends to members of the mothers' clans (Kashaga, 2013). Before the inception of Christianity and Islam, the Haya indigenous community generally shared the same indigenous religion, life philosophy, culture and social (Rweyamamu, 2012). All these indigenous customs and taboos allowed the Haya community to remain strong over for many years, by allowing them to adapt to the different environmental stresses they encountered (c.f. 5.3.2).

### 4.2 General description of the study area

The Kagera Region of Tanzania is located between the longitude of approximately 30° 25' and 32° 40' East of Greenwich, and between the latitude of about 1° 00° and 2° 45' South of Equator. This region borders with Uganda in the north, Burundi and Rwanda in the west, and Lake Victoria in the east. This region has area coverage of approximately 40,838 square kilometers. Out of this, 28,953 square kilometers is land and 11, 885 square kilometers is covered by bodies of fresh water including: Lake Victoria, Lake Burigi, Lake Ikimba and the Ngono and Kagera Rivers. The region is divided into six districts: Muleba, Bukoba Municipal (headquarter of Kagera Region), Kyelwa, Biharamulo, Missenyi, Ngara, Karagwe, and Bukoba Rural. The districts are further sub-divided into divisions, wards and villages. Muleba district has an elevation of approximately 1341 meters above sea level, and Missenyi district has an elevation of about 1530 meters above sea level (URT, 1998). These two districts are inhabited by the Haya who form the dominant ethnic group within the region. Other districts inhabited by the Haya are Bukoba Municipal and Bukoba District.

Geographically, the Kagera region is one of the farthest regions from the commercial city of Dar es Salaam. Kageras' isolation is further compounded its borders with Rwanda and Burundi, which makes it vulnerable to spill over from their conflicts and civil wars. Indeed, the Kagera Region has hosted several refugees from these countries leading to the deterioration of regions' economy and severe environmental degradation (Kessy, 2005, p.6). The Haya people generally live in densely populated village (*ekyaalo*)[10] and engage themselves in the cultivation of perennial crops such as indigenous banana and coffee; seasonal crops such as Maize, beans and bambara nuts; and temporary crops including yams,

[10] *Ekyaalo* means a village in local Haya language, *ekyaaro* is densest populated area dominated with concentration of banana farms surrounding the houses.

sweet potatoes and cassava. The Haya also undertake livestock keeping such as goat, pig, cattle and sheep. According to local community members, these socio-economic activities were once very fruitful as environment in the area was conducive for agricultural activities.

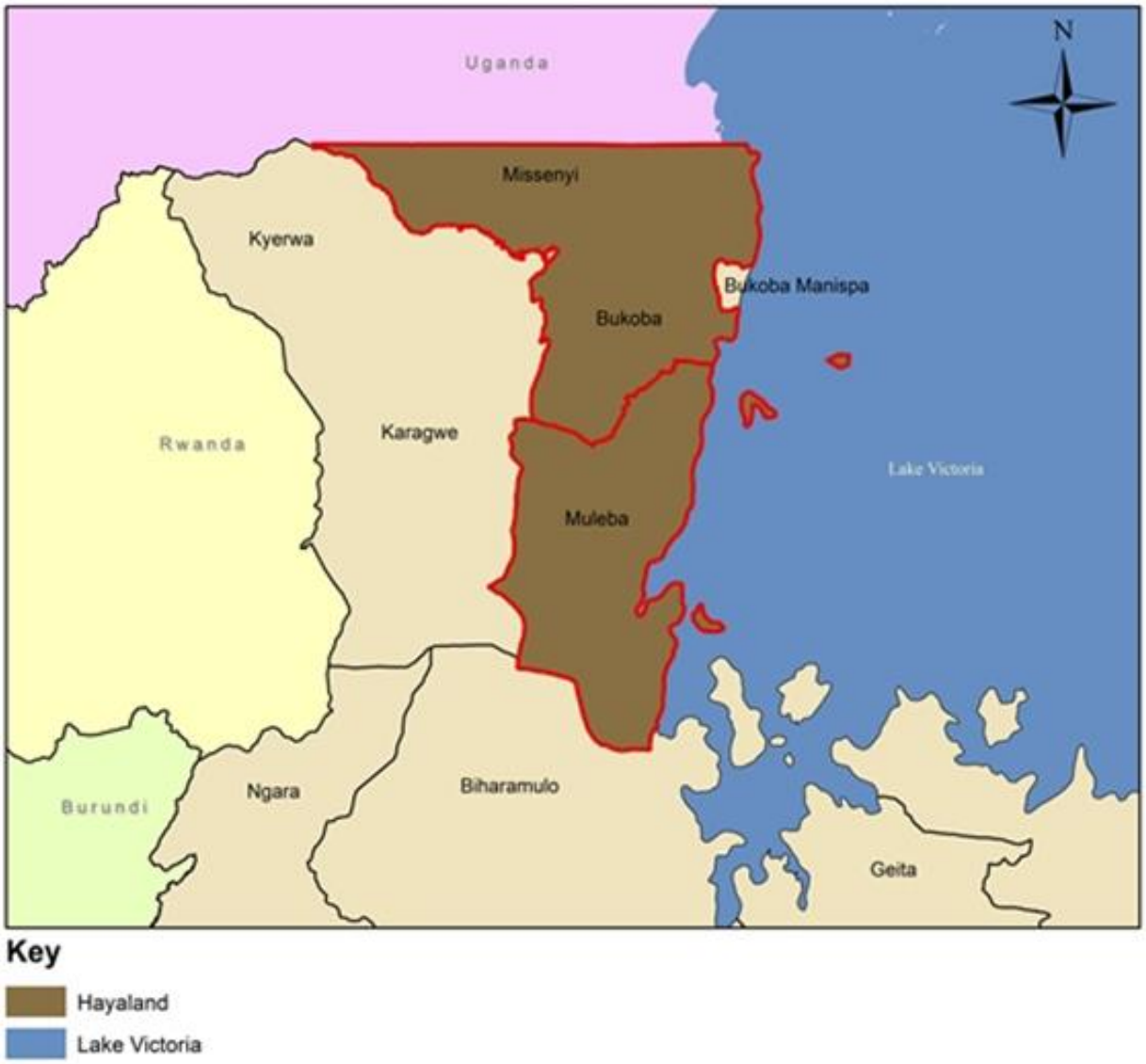


**Figure 7: Map of Kagera Region**

***Source*: *URT (2013)***

### 4.2.1 Physical characteristics of the study area

Kagera Region consists of Lake Victoria, Kagera and Ngono River Basins, which are important for the livelihoods of surrounding communities. However, there are extensive plateaus starting from Kamachumu to Ngote-Karambi, also extensive lowlands, which form

large parts of available wetlands (*amashanga*) in the area and important for grazing livestock and crop farming.

*Lake Victoria*

Lake Victoria was named after the British Queen Victoria by the explorer John Hanning Speak, who was the first British to document it in 1858. The lake has a surface area of approximately 68,800 square kilometers (26,600 square meters). It is the largest lake in Africa, and the largest tropical lake in the world. (Johnson et al. 2000). Lake Victoria receives its water mostly from precipitation as well as from rivers and small streams which drain into it. The largest rivers which drain water into Lake Victoria are the Kagera, Ngono and Mara rivers. Much of the value of this lake however, is derived from its contribution to the development of the country, such fishing, irrigation agriculture, navigation within the Lake Zone regions. It has been playing an important role on the livelihoods of fishing communities surrounding this lake.

*Kagera River Basin*

Kagera River Basin is the largest river basin in the Kagera Region and covers an area between the Kivu, Tanganyika and Victoria lakes. This river basin lies between 00 45’ and 30 35’ south latitude and 290 15’ and 300 51’ longitude east. It drains a basin area of 59,800 square kilometers, which is distributed among the countries of Tanzania (35%), Rwanda (33%), Burundi (22%) and Uganda (10%). The watershed of the Kagera River Basin occupies two major geographical zones namely the West Rift Scarp and the Lake Victoria Basin (Ndayiragije, 1992 cited in Nzeyimana, 2003).

*Ngono River Basin*

The Ngono River Basin is the second largest river basin in the Kagera Region that forms the upper watershed of Lake Victoria. It drains a basin area of about 252 kilometers from the southern part of Muleba District and joins Kagera River to the northern part at Bugorora Ward, Missenyi District before entering Lake Victoria (URT, 1998). The Ngono River drains through a multitude of wetlands The Ngono River enriches these wetlands with fertile soil which it carries from the highland areas. These wetlands within Ngono River Basin have provided a source of livelihood for farmers and livestock keepers for centuries. However, in recent years, some of the wetlands in the Bugorora Ward have been given to private investors, meaning that the local communities are deprived of a place to undertake their

farming and grazing activities. Additionally, the Missenyi District Environmental Office has converted the *Mnene* wetland into a protected area which denies local community access to the pastures and waters in that area.

*Plateaus*

The altitude of the plateau area in the Kagera region is approximately 1,400 meters. These areas are characterized by high rainfall with an average annual rainfall reaching 1000 mm to 1400 mm (URT, 1998). These climate conditions favour the growth of crops such as bananas, maize, beans, coffee and cassava. The districts covered by plateaus are Muleba, Missenyi, Bukoba and portions of the Ngara and Karagwe districts.

*Lowlands*

Large parts of lowland areas in Muleba and Missenyi are drained by the Ngono River. This landmass is important for the livelihood of the community as farmers and livestock keepers depends on these lowlands to undertake their activities. The lowlands areas in Kagera Region are 1,300 meters away from Lake Victoria. It covers parts of the districts of Muleba, Missenyi, Bukoba, most parts of Biharamulo, and Bushubi in Ngara district below the Rubuvu River. The average annual rainfall is generally between 500 mm to 1,000 mm, mono-modal (URT, 1998). Different varieties of crops are grown in the lowland areas including maize, rice, beans, sweet potatoes, cassava and cotton. However, livestock keeping communities rely on the lowlands as their grazing site during long drought seasons.

### 4.2.2 Climatic condition and seasons

Generally, Kagera Region experiences a bi-modal rainfall patterns, with peaks from March to May and and from October to November, with an average annual rainfall of 500 to 2000 mm. Rainfall is higher along the shores of Lake Victoria and tends to decrease with distance from the lake and also with altitude, varying from 2000 mm a year close to Bukoba to 500 mm in the west. Temperatures in the region range from 20 °C to 28 °C throughout the year. The Muleba and Missenyi districts have similar climatic conditions; characterized by mild temperatures and adequate rainfall conducive for cultivation.

Missenyi district experiences two main rainy seasons, from October and December where there is short rain season (*omsenene*) and from March and May where there is long rain season (*toigo*). Along Lake Victoria in Kanyigo ward, the annual rainfall is between 1,000 and 1,400 mm; in the western zone of the district the rainfall is between 600 to 1,000 mm

(URT, 1998). Muleba District is characterized by a humid (> 0.65 p/pet) climate and the landscape of this district is mostly covered with closed broadleaved deciduous forest. The climate of the area is classified as a tropical savanna (winter dry season), with a subtropical moist forest biozone. The soil is high in alisols, acrisols, plinthosols (ac), with a clay-enriched lower horizon and low saturation of bases (Moshi et al. 2012). The banana and coffee growing areas in both districts are mostly found on the tops of hill ridges. The soil within these areas is characterized by high iron and clay content as well as low phosphorus and acid levels. The nitrogen content of the soil in these areas is usually low but artificially maintained by intercropping with legumes, and manuring. High rainfall in the lake shore areas together with poor soil management creates a seriously problem of soil erosion in these areas (*ibid*).

### 4.2.3 The demography of the Haya

In understanding the different strategies exercised by a particular society to adapt to climate change impacts, determining the demographic structure of a given society is quite important. The effect of variables such as, household size and composition as well the adaptive capacity of a household has been widely documented in literature (Juma, 2009). In this study, knowledge of population change is vital in understanding the Haya human ecology. The Haya people are mainly inhabit four districts of Kagera region; Bukoba Municipal, Muleba, Bukoba and Missenyi. In 2005, the Bukoba Rural district was divided to form Missenyi district, and the Bukoba Urban district was divided to form Bukoba Municipal council. The decision to divide these districts was made deliberately by the government to allow easier service delivery within the community. According to the 1988 population and housing census, the former Bukoba Urban district had a population of 46,503 people, the former Bukoba Rural district had a population of 340,800 people, and Muleba district had a population of 273,329 people (URT, 1998). In 2002, the housing census indicated that Bukoba Urban district had a population of 80,868 people, Bukoba Rural district had a population of 394,020 people and Muleba district had a population of 385,184 people (URT, 2006). If we fast forward to 2012 after the creation of Bukoba district and Bukoba Municipal council, the housing census depicts a rapid increase of population with Bukoba Municipal council at 128,796 people, Bukoba District at 289,697 people, Missenyi district at 202,632 people, and Muleba district with 540,310 people (URT, 2012).

The observation I would make here from these figures is that, the population in the Haya community is increasing fairly rapidly and, thus exerting a lot of pressure on the available

scarce resources and facilities such as land, water, vegetation, pasture, education and health. This is manifested by pressing issues of food insecurity, drought, malnutrition and poverty.

### 4.3 Environmental profile of the surveyed villages

The resource maps of the villages of Katanga (Figure 8) and Bugorora (Figure 9) show the local system of utilizing the land resources. In both villages, a large part of the land comprises *bibanja* where local communities grow bananas, coffee, cassava and yams. Many local communities depend on *kibanja* to make their living. However, there is also land designated as grasslands *rweya* for cattle grazing. In recent years, the *rweya* has become important for the cultivation of seasonal crops such as bitter cassava and nuts due to increased land pressure, the loss of soil fertility in the *kibanja* and the decrease of cattle husbandry. Equally, the burgeoning of the market economy has tempted more people to plant pines trees species within the *rweya*. Despite the increasing number of local communities cultivating in *rweya* in recent years, *bibanja* have remained important within the communities due to their socio-cultural importance. Thus, anybody owning the *kibanja* is much respected within the community. Bugorora village has the large government protected forest of Mnene that plays a great role in ecological modification, while in Katanga village there are no protected forests. Bugorora village is thus, less vulnerable to the impacts of climate change risks.

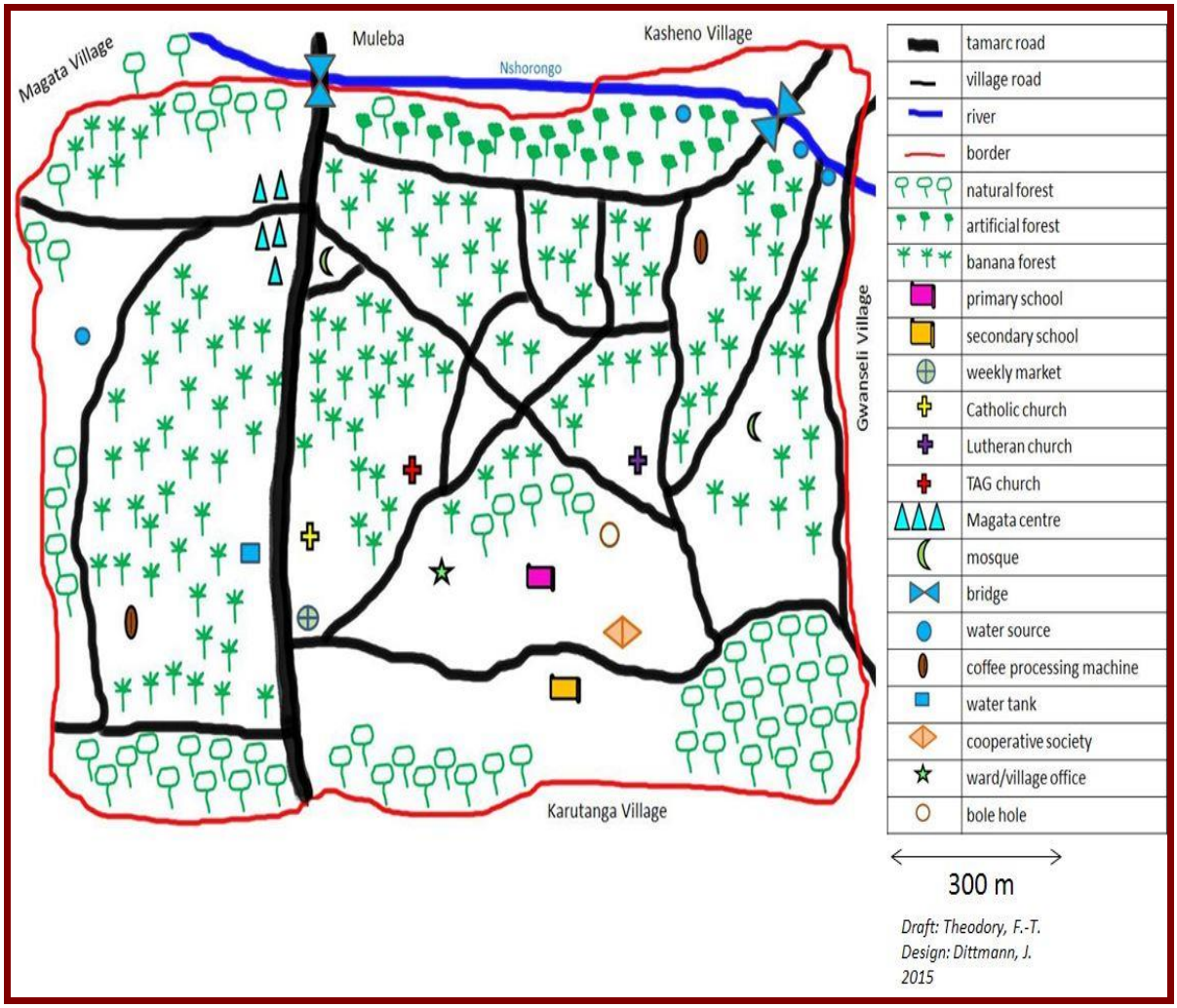


**Figure 8: A resource map of Katanga Village indicating different land uses**

***Source*:** *Fieldwork (2014)*

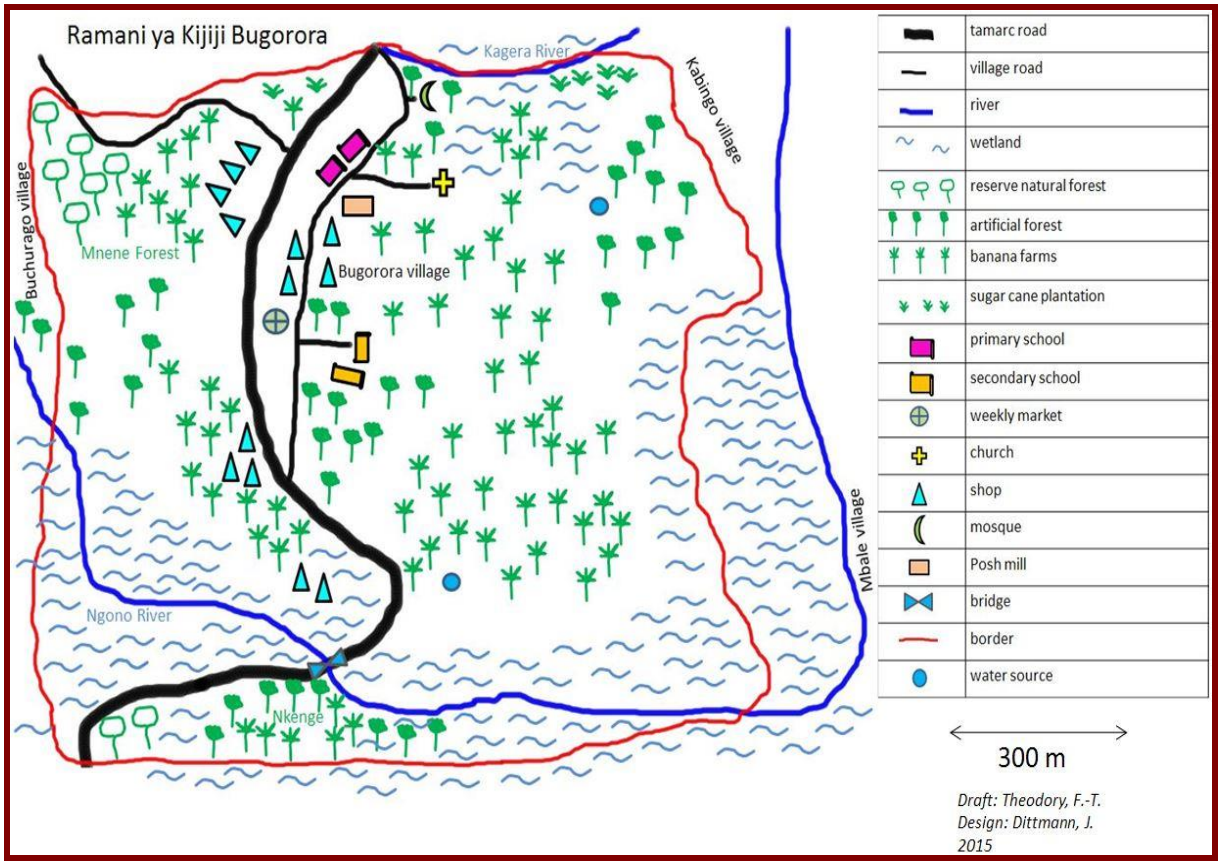


**Figure 9: A resource map of Bugorora Village indicating different land uses**

***Source*:** *Fieldwork (2014)*

### 4.4 Chapter summary

This chapter began with a brief historical context of the Haya people and showed that they migrated from southern Uganda before settling in their present location. Thus, Uganda can be considered as the origin of the Haya. The Haya people, after settling in the Kagera region, established strong indigenous social and political institutions, which took the lead in managing day to day activities and various environmental stresses within the community. Currently, most of these institutions have been affected by the on-going socio-cultural transformation within the communities hence undermine Haya adaptive capacity to changes, particularly climate change. However, this chapter has presented the general description of the study area by explaining what constitutes *Hayaland*. Furthermore, the climatic condition and seasons of the study area have been well described in this chapter. The environmental profiles of two selected villages, which are Katanga and Bugorora, have been presented through resources maps generated by the local communities to depict different land uses in respective villages. It

has been noted that the environment plays a paramount role in the livelihoods of the Haya people despite of being affected by different on-going changes, particularly climate change in recent years.

# Chapter Five

# Confronted with change

> In the past *Hayaland* was a nice place.....agriculture production was very good. We had sufficient food, milk, wild meat and fish resources among other things. The community at that time had strong cohesion and people loved each other. But what is happening in recent years is quite surprising, many things have changed, the abundant food we had is increasingly becoming scarce, fish resources are hardly seen, love within the community has disappeared…..we are currently in big trouble[11].-Magata Village Elder

This chapter endeavours to examine different on-going changes as observed by the local communities in recent years and, how these changes contribute to their vulnerability. Most of these changes undermine local community's adaptive capacity to climate change. The central argument of this chapter is that vulnerability of the Haya people is the result of different factors (climatic and non-climatic factors) which intersect together to produce risks (cf. 2.7). This chapter focuses on four main changes observed within the community: agricultural change, economic change, socio-cultural change and environmental change. Various perspectives of the local communities on the changes observed within the community will be presented. In executing this, I will demonstrate the way local communities put more significance on environmental changes, particularly climate change risks as their livelihood system is intrinsically interwoven with agriculture and livestock keeping activities, which is greatly affected by climate change. This chapter sets the scene for other research questions that will be discussed in the subsequent chapters.

## 5.1 Agricultural changes

The agricultural sector has the primary role of increasing the affordability, and consumption of food, taking into accounts both dietary recommendations and environmental sustainability. Sustainable agriculture production reduces community vulnerability and promotes sustainable development. In light of this, in many developing countries including Tanzania, the agricultural sector is perceived as a mainstay of the national economy. In Tanzania in particular, the agricultural sector contributes immensely to poverty alleviation within rural communities, but faces a number of limitations. The agricultural sector in Tanzania is

[11] Interview with elder on 21st September 2013 at Magata village (Own translation)

dominated by smallholder farmers who cultivate an average farm size ranging between 0.9 hectares (ha) and 3.0 ha each (IPRCC, 2012). The share of the agricultural sector to the nation's economy has been fairly stable as it has accounted for approximately 26.5% of the Gross Domestic Product (GDP). Traditionally, this sector has been considered as the main earner of foreign currency, accounting for approximately 30% of the national export earnings. Domestically, the contribution of agriculture is immense as about 75% of the population in Tanzania is employed in the agriculture sector (URT, 2001). Additionally, domestic agriculture provides 95% of the country's food supply, and due to this, it enhances inflation control since food production contributes about 55.9% of the inflation basket (Kayandabila, 2013). Although this sector seems to be important to the national economy, it is largely rain-fed with only 2% of arable land featuring irrigation infrastructure. This has caused the agricultural sector in Tanzania to be repeatedly affected by climate change related problems such as prolonged drought seasons (FAO, 2009; IPRCC, 2012).

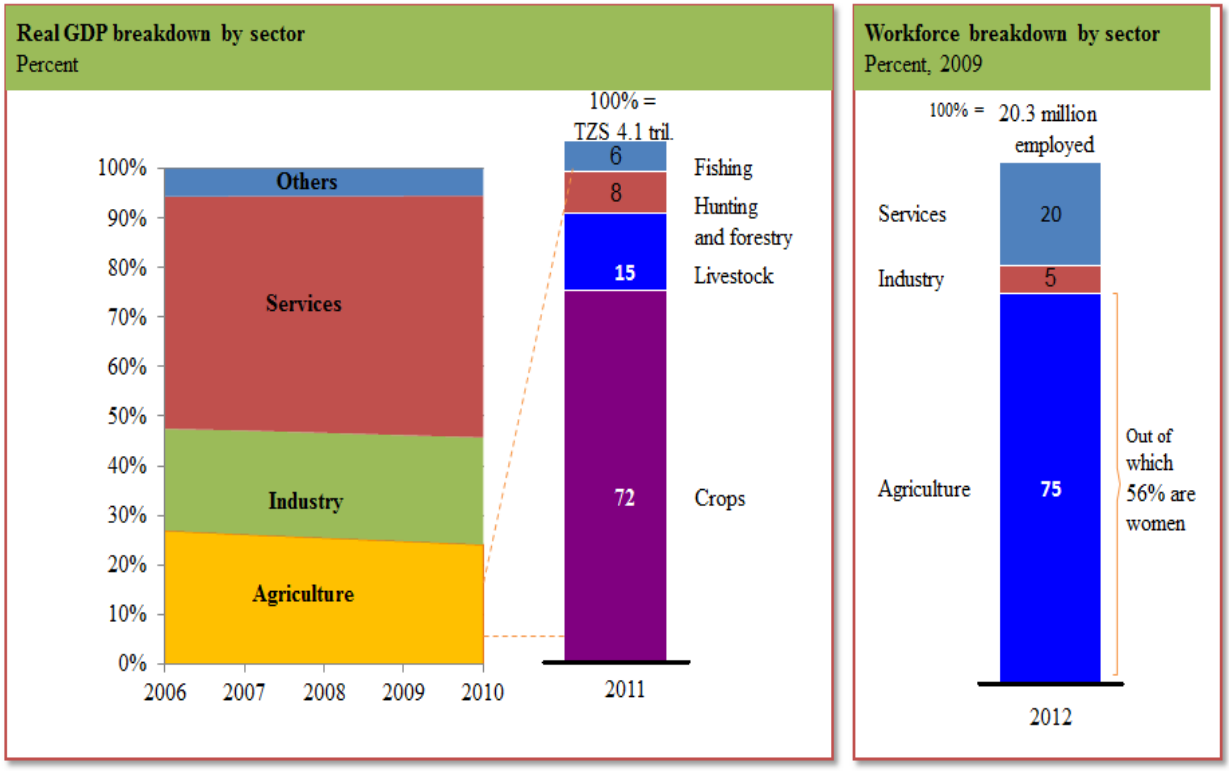


**Figure 10: The contribution of the agricultural sector on poverty reduction**

***Source:*** *Kayandabila (2013)*

Increased agriculture vulnerability to climate variability and change has caused a daunting strategic challenge to this sector. This sector has been underperforming despite its stable annual growth rate of 5%, largely derived from area expansion. Although this rate is greater than the annual population growth rate of 2.9%, it does not have an impact on the lives of the rural population whose major occupation is agriculture (URT, 2013). Considering that the overall GDP growth rate that was targeted for halving abject poverty by 2010 was in the range of 6% to 7%, this performance falls short of the desired growth. As most rural communities depend on subsistence farming, they evade taking risks that could help lift them out of abject poverty and transform agriculture into a more dynamic sector in the economy. Promoting irrigation is thought to stabilize agriculture production in Tanzania, which in turn will assure food security and increase rural people productivity and incomes (IPRCC, 2012).

The agricultural sector has encountered several challenges over the last few years, which has impeded its success in improving the livelihoods of the rural population. The main challenges surrounding include localized food insecurity and recurrent hunger that continues to be influenced by a lack of access to adequate resources such as land, capital and labour (URT, 2001). A number of initiatives focusing on improving the performance of this sector in the country were implemented between the years 1961 to 1980. These initiatives include; the Iringa Declaration of *Siasa ni Kilimo* (Politics is Agriculture), *Kilimo cha Kufa na Kupona* (Life and Death Effort to Improve Agriculture), *Chakula ni Uhai* (Food is Life), *Ukulima wa Kisasa* (Modern Farming) and Arusha Declaration(Ngaiza, 2012, p.3). The first President of the United Republic of Tanzania Julius Kambarage Nyerere after he became on power in 1961, he put the agricultural sector amidst the top priorities of his government. In one of his remarks, the late founding father of the nation said:

> "Because of the importance of agriculture in our development, one would expect that agriculture and the needs of the agricultural producers would be the beginning and the central reference point of all our economic planning. Instead, we have treated agriculture as if it was something peripheral, or just another activity in the country, to be treated at par with all the others, and used by the others without having any special claim upon them….We are neglecting Agriculture. If we are not, every ministry without exception, and every parastatal and every party meeting would be working on direct and indirect needs of the agricultural producers …..We must now stop this neglect of agriculture. We must now give it the central place in all our development planning. For agriculture is indeed the foundation of all our progress" (Zhihong et al. 2014, p.48).

In line with this, the current Tanzanian Government has also placed the agricultural sector at the centre of the country's economy. In recent years, more serious action has been directed to the implementation of the Agricultural Sector Development Program (ASDP) across the country. Different initiatives have been established such as *Kilimo Kwanza* (Agriculture First) focusing on transforming the agricultural sector. *Kilimo Kwanza* was launched by the fourth retired president of Tanzania Dr. Jakaya Mrisho Kikwete in Dodoma on 3rd August 2009, in order to reach a number of development goals by 2025 (Zhihong et al. 2014)[12]. This campaign seeks to generate foreign direct investment (FDI), to maintain large-scale agribusiness, and to transform small-scale farmers into commercial farmers using the model of the Green Revolution. The *Kilimo Kwanza* campaign has won substantial financial support from the Alliance for a Green Revolution in Africa (AGRA) (Smucker et al. 2015).

Despite different initiatives undertaken by the government, the agricultural sector does not look promising, particularly for the rural poor population. In the context of the Haya in the Ngono River Basin, the situation is becoming worse due to different agricultural changes, which have been observed by local communities in recent years. To some extent these changes affect the overall performance of this sector in improving the livelihoods of the Haya. In the following sub-sections, major agricultural changes as observed by the local communities are presented and explained in detail.

### 5.1.1 Decreasing productivity of the home garden (*kibanja*)

Home gardens (*bibanja*) are broadly distributed throughout the globe and have been extensively documented by different scholars (Soemarwoto, 1987; Rugalema et al. 1994). This type of farming is crucial for subsistence and represents a 'risk-spreading' farming system (Oduol and Aluma, 1990). In the Haya community, *kibanja* was already well established in the late 19th century (Hyden, 1969), and since then, the cultivation of *kibanja* has been the dominating agricultural activity in the area. The most popular crops grown on the *kibanja* are bananas for food, and coffee as a cash crop. These two crops are grown in the *kibanja* alongside other seasonal crops including maize and beans, as well as temporary crops such as cassava and yams. *Kibanja* produced good returns until the beginning of 20th century, due to intensive care by farmers and a favourable climate. However, in more recent years a

[12] *Kilimo Kwanza* means the modernization of agriculture: increasing crop production, increasing livestock husbandry and undertaking fish farming. In crop production the aim is to: increase the acreage under cultivation by using modern farm tools such as tractors and power tillers, improving knowledge, increasing the acreage under irrigation, using improved seeds and fertilizer, controlling pests and diseases, and investing in large scale farming.

combination of factors, including increased soil infertility and reduced precipitation have substantially reduced the yields of *kibanja*.

Farmers report that in recent years, the productivity of their *bibanja* has decreased tremendously leading to recurrent food insecurity. In the past, the food produced in most of the *bibanja* was sufficient to feed the family throughout the year. This problem was heavily discussed during the focus group discussions in order to understand the underlying causes of the reduction in the productivity of the *bibanja*. One respondent had the following remarks concerning the decrease of *bibanja* productivity:

> …….in the past I used to cultivate a small portion of land and harvest much, but in recent years the production has decreased despite cultivating a larger portion of land. I am using a lot of energy and spending most of my time working in my *kibanja*, but surprisingly what is being harvested is quite disappointing. Just imagine last year I harvested only 30 bunches of banana, 20 kg of coffee, 13 kg of beans and 10 kg of maize. All these harvests were from 3 hectares of my *kibanja*…this is a serious decrease of production of my *kibanja* compared to the past 30 years where I used to have harvests up to 100 bunches of bananas, 150 kg of coffee, 80 kg of beans and 100 kg of maize from only two hectares. With this decrease, I have found myself in big trouble, what I have been harvesting in recent years cannot feed my family even for three month. I have to visit shops to buy extra food for my family[13].

The above scenario indicates that the productivity of *kibanja* has significantly declined over the last few decades. Most of the families in the study area can no longer rely on *kibanja* alone for their daily subsistence. In 1970 Moody (1970) observed that the production of banana then was 3,363.3 kg/ha/year and coffee was 235 kg/ha/year. Since one bunch of banana is presumed to weigh 15 kg (Acland, 1971); the harvests per hectare of *kibanja* was 224 bunches per year. However, Rugalema et al (1994) revealed that the average banana output in Bukoba in 1994 was around 175 bunches per hectare per year. Thus, we can see a clear decrease in productivity over the years. With this alarming situation, most of households have decided to extend their farming activities into other supplementary plots (*musiri*). Within the *musiri*, local communities have been cultivating temporary crops, particularly root crops such as sweet potatoes, yams and cassava to supplement banana production.

Despite this extended farming, the harvests still cannot feed families throughout the year. In the past, only a few families extended their farming activities to the *musiri* because the

[13] Interview conducted on 21st August 2013 at Magata village (Own translation)

*bibanja* were producing enough food for the family consumption. This is confirmed by Muruo (2002) that at the time of independence in 1961, cultivation in *musiri* was perceived as entirely optional. The Haya did not need to grow root crops such as cassava or sweet potatoes more intensively than they needed for consumption whereas now, every family cultivates sweet potatoes and cassava plots out of necessity. One old respondent from Katanga village who owns a large *kibanja* as well as supplementary plots elucidated his experiences regarding the overall decrease of production in the following manner:

> ….. I own approximately five hectares of *kibanja* planted with a new banana species and coffee. However, I have another two hectares of *musiri* where my family cultivates sweet potatoes, cassava and yams. Despite having such a big plot alongside the *kibanja*, the yields from these two plots cannot feed my family throughout the year. I don't know what has happened to the soil, because its productive capacity keeps decreasing from time to time. The situation we are currently undergoing is quite new especially for the old people like me. In the past my family could survive by getting enough food from the *kibanja* alone. All supplementary plots were not cultivated. But nowadays we are cultivating our supplementary plots but the harvests are still not enough[14].

Generally, most of the participants of this study felt that their *bibanja* and supplementary plots altogether could sustain their families for most part of the year, but the general feeling was that there is a shift towards purchasing food from shops and kiosks. At the time this study was conducted, there were many shops available in the studied villages. I spent some time at one of the shops in Kabingo village in order to observe what kinds of goods were being purchased by the local communities. After I had spent almost four hours at the shop, I came to realize that most of the customers were either buying maize flour or rice. The owners of various shops within the community admitted that in recent years their businesses were making good headway, because most of the community members often buy food from their shops and kiosks instead of harvesting it from their *bibanja* or *musiri*. One participant who owns a small kiosk explained how his business was making good progress:

> …….usually I open my kiosk in the afternoon after I have worked in my *kibanja* during the morning hours. Once I open my kiosk in the afternoon, most of the customers who visit my kiosk during that time, usually buy maize floor or rice. Nowadays, I can sell up to 30 kg of maize flour per day and 15 kg of rice per day. It seems most of the people in this village have adapted to these types of food such as *ugali* and rice, the type of food which they never ate before. In the past 20 years, it was difficult even to sell 5 kg of maize flour per day. However, most of the families used to buy rice during Christmas or Easter festivals. In recent years, such types of foods are in high demand and they are predominant goods mostly

[14] Focus group discussion on 23rd August 2013 at Katanga village (Own translation)

> purchased by the local communities from different shops and kiosks. This is an indication of the decrease of productivity of the *kibanja* within the village[15].

The increased dependency on shops and kiosks has caused even more of decrease in the productivity of the *kibanja*, since most local community members concentrate on paid jobs such as working in other people's *bibanja* in order to get money for buying food. This in turn has caused other people to abandon their *bibanja* for quite a long time. Most of the *bibanja* that were observed during the transect walks were full of weeds, which further reduces their productivity. The situation is even worse in Mbale village, where I observed most of the *bibanja* abandoned by their owners for many years. Most of the owners of those *bibanja* were the youth, generally between 20 to 35 years old. For them taking care of the *kibanja* was not a priority, and they were of the view that spending most of their time working in the *kibanja* would starve their families. Youth participants in the focus group discussion in Bugorora village felt that it was imperative to seek paid jobs, where they can easily get money to purchase food from shops or kiosks for their families.

The question of abandoning *bibanja* within the study village received a great deal of attention from the participants of this study. There was a significant split in option between the older and younger participants. Most of the old participants felt that working in the *kibanja* was a priority over paid jobs as owning the *kibanja* is considered honourable. They felt that the owner of the *kibanja* is required to take care of it irrespective of poor returns. One older participant gave the following remarks regarding the youth's decision to abandon their *bibanja* and how it contributes to food insecurity and poverty within the community:

> …..…the youth in this village do not engage in agricultural activities like the old population. Therefore, if the young generation, who are more energetic than me, are not involved in agriculture what do you think will happen to food security in this village? This is the challenge to our community, the young generation has a negative perception regarding whether agriculture activities can help them to get out of poverty. They are involved more in other activities, in which they can easily generate money within a short time like paid jobs, entrepreneurship, riding motorcycles (*bodaboda*) and brick making. You find a certain household with ten members, but only three members, mainly the old are working in the *kibanja*……youths do not work in the *kibanja* instead they spend most of their time at *kijiweni*[16] and in local pubs drinking local alcohol. If you have time to visit

[15] Interview conducted on 23rd October 2013 at Kabingo village (Own translation)

[16] *Kijiweni* is Swahili slang explaining a place to hang out. It is a place where people meet, get information on what is happening in the street or village and exchange ideas or world views in a relaxed manner.

> local pubs in the morning you will find youths drinking local alcohol there, during time that could have been spent working in the *kibanja*[17].

As we can see, the withdrawal of the working age population from working in the *kibanja* has contributed much to the decrease of *kibanja* productivity and hence food insecurity. During the transect walks within the study villages some of the *bibanja* were observed to be in poor condition and it seemed that most of them had been unattended for quite long time. One of the Catholic Parish Priests I interviewed at Mugana Parish had the following remarks on the deterioration of the *kibanja*:

> In recent years I have observed most of the *bibanja* within the community are in poor condition with a lot of weeds, while others are completely abandoned by their owners. In the past local community members worked in their *bibanja* every day, this kept them attractive throughout the year without weeds. People were undertaking regular weeding and mulching with grasses to deter weed regeneration. During that time, mulching grasses were plenty and easily accessed around the village. Currently, those grasses are unavailable, which makes it difficult to mulch the *kibanja*, this favours weeds growth consequently the returns from the *kibanja* is decreasing. Getting access to grasses needs a lot of investments including money and labour. These are the reasons for most of the farms in this village being in poor condition and others being abandoned by their owners[18].

With the capacity of the *bibanja* to produce sufficient food for the family decreasing over time along with the lack of involvement of the working age population in farming activities, there is a danger the communities will face severe food insecurity in the coming years. Local communities have reported that they have been experienced recurrent hunger for the last ten years. Thus we can see a clear change in the status of the *bibanja* over time with its role as the main provider of food for the community being taken over by shops and kiosks.

[17] Focus group discussion on 20th September 2013 at Magata village (Own translation)
[18] Interview with catholic priest on 20th October 2014 at Mugana Catholic Church (Own translation)

**Figure 11: One of the *kibanja* in Karutanga Village with poor condition**

***Source***: *Fieldwork (2014)*

### 5.1.2 Incidences of banana's pests and diseases

The study area is well recognized as "the land of banana" or a hotspot of "banana culture". Bananas are the dominant staple food for over 2.4 million inhabitants in the study area (URT, 2012). About one-third of the total banana production in Tanzania is produced in Kagera Region, where in the 2010/2011 harvest season, banana production was 2.3 metric tonnes. Banana production takes up about 90 % of the region's economically active population, and is mostly subsistence based as many people depend on bananas for their daily source of carbohydrates (Mulisa, 2013). Furthermore, banana production is often practiced on small plots averaging 0.5 hectares per farming household (Bosch and Shwagala, 1994). However, it can also provide a source of income for the local communities as excess production is sold at the market. The farming of bananas also has the ecological function of protecting the soil from erosion and leaching (Rugalema and Mathieson, 2009).

In the last thirty years or so, banana production in the study area has been declining. The average yield of bananas decreased from 18 tonnes/hectare per year in the 1960s to less than 6 tonnes/hectare per year in the late 1980s (Walker et al. 1984; Sikora et al. 1989). The incidences of pests and diseases have brought substantial changes to this sector and are considered to be one of the major causes of the decline in banana production. The most serious disease mentioned in every interview was BXW. Despite the relative importance of the banana in the region for food security and the local community's' income and livelihoods, the crop has been very vulnerable to BXW disease which has caused great losses of banana production in the region. If not controlled, BXW may cause up to 100% of a plantation to be lost. According to Muleba District Agricultural Officer (DAO), since late 2000s the majority of local communities in Kagera region have been affected by BXW, which has consequently jeopardized their food security and livelihoods. Local communities revealed that food insecurity is a major problem in the villages despite having other types of food aside from the indigenous banana (*matoke*). Because bananas are the preferred food of the Haya people, when they speak of food insecurity, it is in reference to a lack of indigenous banana. The Food and Agriculture Organization (FAO) defined food security as follows:

> "Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (World Food Summit 1996, p.4).

As BXW spread across the region, in the year 2012 the government authorities in Kagera region declared BXW a regional disaster, requiring immediate interventions. Most of the participants reported that this disease was spreading too fast and caused a lot of damage to the *kibanja*. Some even worry that banana production within *Hayaland* will cease within the next few decades. One respondent explicated his concerns regarding the incidence of BXW disease that was threatening the production of indigenous banana as follows:

> …..I'm suspicious of whether the coming generation will be lucky enough to see and eat indigenous banana. In fact, the prevalence rate of this disease is high and the production of indigenous banana is decreasing too fast. Perhaps if the government gets a permanent solution to eradicate this disease, this can rescue the future generations from the shortage of indigenous banana. For instance, in one ward in the village of Ishozi it is difficult to find any indigenous banana like *enkande* and *entobe* because of this disease[19].

[19] Interview conducted on 15th October 2013 at Mbale village (Own translation)

The prevalence of BXW is also reported to have jeopardized the livelihoods of millions of farmers in Eastern and Central Africa including Burundi, Rwanda, Kenya, Uganda, and The Democratic Republic of Congo (Tushemereirwe et al. 2004; Kalyebara et al. 2007). The disease was first reported in Ethiopia in Ensete about 40 years ago (Yirgou and Bradbury, 1968). In Tanzania, the first case of BXW was in January 2006 at Kabale village, Muleba District. The situation has since become substantially worse and within one year it spread to almost all parts of Kagera Region (Mgenzi et al. 2006).

**Figure 12: Banana affected with BXW (*mnyauko*) disease in the *kibanja***

***Source*: *Fieldwork (2014)***

In the Kagera Region, all major banana producing districts have been affected by this disease. Harvest losses are related with premature ripening and rotting of banana fruits even in the absence of external symptoms of the disease. The end stage of the disease is the wilting and death of the banana plants. The high prevalence of disease is part of the reason why so many farmers have abandoned their banana *bibanja*. In order to reverse the loss of banana yields,

serious interventions to curb BXW need to be taken immediately so as to ensure the food security and sustainable livelihoods of the community.

### 5.1.3 Land use change

Another important agricultural change observed by local communities in the study area is the change in land use. Traditionally, the farming system of the Haya has been comprised of three different, but closely related to land types; *kibanja*-the home garden, *rweya*-the land used for communal grazing, shifting cultivation and source of thatch/mulch grass, as well as *kikamba*-the area used to cultivate annual crops such as maize, beans and roots. Traditionally, the crops cultivated in *kibanja* are bananas, coffee, maize, beans, cassava, taro and different fruit trees such as mango, guava and orange. Indigenous trees were also planted in the *kibanja*, including: umbrella trees, blume, moraceae and palm tree. Other crops like maize, sweet potatoes, cassava, yams and occasionally taro were also cultivated in the *kibanja*. The crops traditionally grown in the *rweya* include bambara nuts, yams, cassava, and sometimes the same crops under shifting cultivation in the *musiri*. Cultivation of trees such as pines and tea were also cultivated in the *rweya*.

In recent years the land uses within *Hayaland* have undergone dramatic modifications. In the past it was not possible for the local communities to transform a land type into a different one. This was to conserve the environment for a particular land use. Today, in the study area it is evident that the changes in the use of the *rweya* as well as economic drivers have stimulated local communities to plant more trees everywhere to sell the lumber. The participants reported that, in the past, the *rweya* was public and every person had the right to access *rweya* for cultivating different crops and grazing livestock. Under the current land policy however, *rweya* is a privately owned asset with owners increasingly planting trees especially pines species. The community has been left with no place to undertake supplementary farming and grazing of livestock. One of the participants had the following remark regarding land use changes of the study area:

> …....in the past our land was divided into different functional land use types such as *kibanja*, *rweya*, *musiri* and *kikamba*. This was undertaken because there are varieties of crops which are specifically grown within *kibanja*. Within a *kibanja* perennial crops like banana and coffee grow better than in any other places like *rweya* and *kikamba*. In recent years, the land use has been transformed. The function of *rweya* is no longer as grazing land or cultivation of crops such as

> bambara nuts only…currently people have planted a lot of pines trees, which I think are bringing all problems of unproductive soil[20].

It also emerged from the focus group discussion that some local communities have started planting exotic trees in their *bibanja*. In the past only indigenous trees such as umbrella, blume, moraceae and palm tree were grown. Those trees played an important ecological function within the *kibanja* and controlled soil erosion. During the transect walk across the study area I observed that exotic trees like pines being planted within the *bibanja*. According to focus group participants, the exotic trees were being grown within the *bibanja* in order to find an alternative way of generating swift income from pines trees, which grow fast under any soil conditions. This decision however, was creating more problems than solutions as the pines trees were undermining the productivity of the *kibanja.* It was observed that where pines are grown nothing can germinate as the pines siphon a great deal of resources away from the other crops; therefore, the decision to plant pines within the *kibanja* has daunted its productive capacity.

**Figure 13: Pines planted within the *kibanja***

***Source:*** *Fieldwork (2014)*

[20] Interview conducted on 24th September 2013 at Magata Village (Own translation)

The decrease in the productivity of the *bibanja* has forced the community to depend more on root crops such as sweet potatoes, yams and cassava. This has caused the community to extend their farming activities to the *kikamba* and *musiri* at the expense of the *rweya*, which has led to shorter fallow periods in the *kikamba*. Due to shorter fallow period, the yields from *kikamba* and *musiri* have been decreasing from season to season and those areas are more prone to land degradation. The continuation of farming within these areas will reduce the amount the grazing land available for livestock in the long run and create a scarcity of thatch and mulching grass. Most livestock keepers have decided to reduce their herds of cattle due to the lack of grazing land. This in turn has reduced the production of manure, which can be used to improve the productivity of the *kibanja*. The effect of the land use changes in the study area was explained by a DAO of Muleba as follows:

> ……land use change in this region has contributed greatly to the decrease of productivity in different farming systems. To a great extent this has been fostered by population growth, which increased the demand for food and *bibanja* are becoming too small to feed the existing population. This has triggered local communities to expand their farming activities within the *rweya* which creates scarcities of grazing areas for livestock. Since there is a shortage of grazing land, many owners of livestock have decided to reduce their herds of cattle. This has big implications on manure production because in recent years we have observed the decrease of manure that is used to improve the fertility of the soil and crop health. This is the reason for most bananas are vulnerable to diseases and pests as their resistance is low.[21].

The increased vulnerability of bananas to pests and diseases has reduced the productivity of the *bibanja* to a great extent. This has caused local communities to focus on maize and root crops farming within less productive *bibanja* as well as in *musiri, kikamba* and *rweya*. Since there are no inputs added within these farming systems because of the lack of manure, the problem of soil infertility continues, as does the decreases in production, and consequently the community become more vulnerable.

### 5.1.4 Increasing land shortages

Land is the main asset from which the poor population is able to derive their livelihood. In Tanzania, land is considered a major determinant of individual, household and community poverty (URT, 1995). Several studies have shown that many poor people in Tanzania consider land to be an asset of the family that can be sold to address different family problems such as building of a house, paying dowry or bride price, capital for business, etc. (see Kironde, 1995; Sanga, 2009). Many people in Tanzania use land as collateral when

[21] Interview with District Agriculture Officer, Muleba, 2nd September 2013

accessing credit from formal financial institutions such as banks. Without land, the poor would face even greater poverty (Sundet, 2004).

In 1974, the Tanzanian government initiated the 'Villagisation Policy', which grew out of the experience of the original '*Ujamaa* village programme' in 1967 (Kjekshus, 1977). The basic idea of 'villagisation' is "regroupment into villages, which usually does not involve moving significant distances. The houses in the villages may be laid out in straight lines, in a grid pattern, but this is not always the case" (Lorgen, 1999, p.12). In the Tanzanian case, the villagisation policy redrew the administrative map of the countryside. It was an overarching component of the country's development plans following its policies of *Ujamaa* (*family hood in Swahili language*). Designed by the late Julius Kambarage Nyerere, Ujamaa was promoted as 'traditional African socialism'. During the *Ujamaa* era, the ownership of land was highly debated and private acquisition of land was extremely difficult. In the early 1980s, the 'African crisis' hit Tanzania and measures of structural adjustment had to be implemented (Sundet, 2004).

In 1983, the government established a new National Agricultural Policy (NAP), which many be understood to be a reversal of villagisation and the demise of *Ujamaa* since large-scale agriculture was expanded by the government. Since then, the demand for land has been mounting, and the majority rural population experienced land shortages and an increased agricultural burden on the existing land. In this respect, the administration of land became one of the most pressing issues facing the government. In 1990s, a programme of economic liberalisation was supplemented by a political reform process, and the one party government system was amended to a multi-party system. It was in this milieu of substantial change that the government decided to establish the new National Land Policy. This process of policy formulation took more than five years and involved a number of interested stakeholders, particularly a Presidential Commission of Inquiry and a core committee of senior civil servants. The new National Land Policy was launched as a "turning point in the development of Tanzania" (URT, 1995, p.ii).

It was hoped that the establishment of National Land Policy would solve most of the pressing issues facing the rural population, such as decreased land availability and the increased burdens on existing land. Twenty years have passed since the National Land Policy was enacted by the government, but the rural population is still facing a multitude of land related problems. Evidence from the field indicates that land grabbing is occurring in the study area

under the guise of of land investments, game reserves and conservation areas. These land acquisitions are sometimes undertaken without the informed consent of the affected land-users, which creates land shortages. It was revealed during the focus group discussions that some village land was taken by the government. This land was taken without effective democratic planning, meaningful participation and independent oversight from the local community. This situation was reported in Bugorora village where both local authorities and the community were unhappy with the government's decision to convert the Ngono wetland area into a conservation area. In the past local communities relied on that land for their livelihood, using it for agriculture and grazing of livestock. Currently, such activities are strictly prohibited adjacent the wetland, which adds more pressure to the existing land. Land shortages are increasingly being felt within the villages surrounding this wetland, because people have to do all their livelihood activities within the *kibanja*, which in turn, contribute to soil infertility and reduced productivity. One of the participants outlined how the government decision to convert the Ngono wetland area has affected the community:

> ……the government has converted the Ngono wetland area into a conservation area. This wetland was important to the community for agriculture especially during long dry seasons. I remember in 1997 if not for this wetland we could have died due to hunger. There was a long dry season that caused drought in the Missenyi District....villagers had to undertake farming activities in this wetland and it helped us a lot as we were able to harvests enough sweet potatoes. Since this wetland has been transformed to a conservation area, we are not allowed to undertake any farming activities within it. This creates land shortages as we don't have a big *bibanja* to sustain our family during drought season[22].

Furthermore, in some of the villages such as Magata and Katanga, the local community condemned the village authorities for not being transparent when they signed land contracts with different investors. Currently, no one can say accurately how much land has been leased to the investors. Many of these land lease deals in the different villages are characterized by confidentiality and a lack of transparency. Many local community members have expressed concerns over those contracts as they do not specify any clear and binding commitments for benefits to the local community. Due to the lack of these clarifications, local communities have found themselves in conflict with the investors. It was reported during a focus group discussions that various investors have been filing complaints accusing local people of undertaking farming and grazing activities on their land. During the transect walk in Katanga

[22] Focus group discussion on 13th October 2013 at Bugorora village (Own translation)

village, I came across a few children that had been caught by one of the investors collecting fuel wood on his plot. I wanted to get his perspective on the land shortage problem. This investor who owns 15 hectares of land had the following remarks:

> ….I bought this land from the village government specifically for my tree project…..I don't care and this is none of my business to know where the rest of the community will undertake farming. ….I bought this land after the advertisement made by the village government to request people who were ready to invest on village land. I paid money to get this land and I have invested a lot of money in planting these pine trees. I'm really annoyed if I find anybody trying to play with my money by chopping either fuel wood or undertaking farming activities[23].

The above remarks indicate that the rural poor are becoming increasingly vulnerable because they are unable to obtain large tracts of land for different uses. Rich people are being favoured by the market system due to their financial capacity. The on-going situation in Tanzania is that rich investors are buying up land at the expense of the livelihoods of the rural poor. There have been reports of clashes between investors and local communities over land administration in several districts, including Missenyi, Muleba, Mvomero, Kilwa, Bagamoyo, Loliondo.

Despite those conflicts over land administration, the Tanzanian government, with support from the private sector launched the *Kilimo Kwanza* initiatives in 2009 (cf. 5.1). The objective of *Kilimo Kwanza* is to refocus the agriculture sector by promoting large-scale agribusiness and also, to convert small-scale farmers into commercial small farmers on the model of the Green Revolution (Smucker et al. 2015). In order to accomplish this, *Kilimo Kwanza* aims to enhance land availability for large-scale capital investment and production. To this end, the Village Land Act No. 5 of 1999 was amended in 2004 to enable investors to have easier access to village land. As of now, *Kilimo Kwanza* seems to inspire nothing but fear in small farmers. The fact is that, the arable land, which for centuries has been used by local communities, will be taken by the large investors leaving the farmers with limited land to extend their farming activities. This scenario does not seem likely to improve the lives of the rural poor population rather than increasing their vulnerability to climate change.

This situation is already evident in the study area. During transect walks and participatory observation, it was observed that large tracts of land in Bugorora ward have been leased to a private company known as Global Agency Limited. This company has leased more than

[23] Interview conducted on 28th September 2013 at Katanga village (Own translation)

3,500 hectares of land to undertake agricultural activities in Buchurago and Kabingo villages. Although the company acquired the land following the legal procedures stipulated in the Village Land Act N. 5 of 1999, local communities were deeply unhappy with the process. The process was done in secret, and only local authorities were involved in signing the contracts.

**Figure 14: Large-scale farming in Bugorora undertaken by Global Agency Company**

***Source*:** *Fieldwork (2014)*

In addition to the issue of land shortages, local communities were suspicious if in twenty years to come land will be enough to fulfil the population demands. Some of the participants went further and projected that the issue of land will be another crisis within the community. One old participant had the following sentiments regarding land shortage crisis:

> My son land question is becoming a serious issue within the community. If no substantial measures taken children will kill us so as to own the land. There are different cases concerning the issue of land in different families whereby a child is forcing his parents to get his heritage of land. All this happens while a child understands that it is contrary to Haya traditions, customs and taboos, for a child to inherit land or whatsoever from his parents if both parents still living. Most of

children have been blaming their parents for not giving them the land, and this triggers conflicts within the family[24].

### 5.2 Economic changes

Some of agricultural changes discussed above have contributed to negative economic changes within the study area which have seriously affected the economic performance of the local communities. The most important economic changes were identified through the focus group discussions and interviews with elders. Market access problems, the decline of farm earnings and food price volatility were ranked as the most important economic changes.

#### 5.2.1 Market access problems

It was reported by the participants in two districts that market access was a pressing issue. The economy of the study area depends heavily on agriculture, fishing and livestock keeping. Coffee is the major cash crop within the region, and from 1994-1997, the production of coffee was good and its price was encouraging. After 1997 the price of coffee began to fluctuate. It is reported that the price of coffee was especially good for farmers who were living close to the Ugandan boarder. They sold coffee to Ugandan business men at a price range from 500 Tshs to a maximum of 700 Tshs per kilogram. This price was good compared to the price offered by a cooperative union known as Kagera Cooperative Union (KCU), which ranged from 200 Tshs to a maximum of 300 Tshs per kilogram. Up to the present the price of coffee in the Ugandan market is still better when compared to the prices in the Tanzanian market.[25]

It was further reported that in recent years the government has imposed strong regulations aiming at discouraging the smuggling of coffee from Tanzania to Uganda. Indeed most of the coffee produced in the study area was sold illegally to Uganda. The government urged farmers to sell their coffee to cooperative societies instead of unauthorized business men from either Uganda. According to a Missenyi District Agricultural Officer, the smuggling of coffee to Uganda was denying the government billions of shillings worth of foreign trade. She argued that coffee growers should team up under the canopy of the KCU and sell their coffee directly to markets. In my view, I don't think this can be easily achieved given the state of affairs of the KCU. The KCU is on the verge of collapse because theft, embezzlement and mismanagement which has left the cooperative debt-ridden. This has affected the coffee market in the study area as farmers have to depend on the KCU. The income is not reliable

[24] Interview conducted on 28th September 2013 at Magata village (Own translation)
[25] 1 Euro is equivalent to 2450 Tanzanian Shillings (Current exchange rate)

because the price of coffee fluctuates from season to season with the KCU and farmers have to sell their coffee to KCU on credit which means they are not paid instantly. These factors have led to a decrease in coffee farming.

Around the late 1990s some farmers decided to engage in vanilla farming after experiencing price fluctuations with coffee. Initially the price of vanilla was good and attracted a great deal of farmers. However, the over-abundance of vanilla farmers caused a decline in its price over the next few years. During the village transect walk, I observed several abandoned vanilla farms. The market for bananas was also experiencing problems during the time this study was undertaken. Most of the farmers sell their banana to middlemen who ship them to Mwanza City where there is large market. According to one of the middlemen, shipping bananas to Mwanza was a challenge because the only working cargo ship MV Victoria, was out of commission. Researchers such as Kessy (2005) have argued that market access problems in Kagera region are due to the repatriation operation of refugees from Rwanda and Burundi, which has decreased the market for bananas and beans. From the above insights, it is apparent that local communities in the study area are suffering due to market failure. This again contributes to community vulnerability, as it was explained by different participants that their poverty makes it difficult to get access to medical services, buy food and pay tuition fees for their children.

### 5.2.2 Decline of *kibanja* and farm income

The earnings from different farming systems and *kibanja* have been decreasing in recent years. As it has been explained previously in this chapter, the decrease of banana and coffee production has had negative implications for farm incomes among farmers. In the past farmers were able to fulfil most of the important family requirements such as food, tuition, and medical costs using income generated from selling the yields from their *bibanja* and farms. The *bibanja* had good returns, because farmers could fully engage in both food crop and cash crop production. In recent years however, the yields from both crop types have decreased due to crop pests and disease, climate change and soil infertility. Interviews with different elders in Magata, Karutanga and Mbale revealed that the earnings from *bibanja* and farms depended mainly on coffee and bananas, thus the decreased production of both crops has affected their household income. One of my participants gave an account on how the decrease in coffee production had affected her household income:

> Previously it was possible to harvest up to 10 bags of coffee. My husband could sell the coffee at the cooperative society and get money to fulfil different family needs. Currently, it is difficult to harvest even three bags of coffee during good seasons. If it is a bad season you cannot even harvest one bag. This has reduced our farm earnings to a great extent and it is difficult getting out of poverty with this trend. Due to this we are unable to meet some family basic needs[26].

The Haya are famous for producing local drinks such as local juice (*omulamba*), local beer (*lubisi*) and local liquor (*konyagi*). Those drinks are produced by using special bananas called *embire*. It was reported that local communities have been involved in this type of production for decades and it has contributed to poverty alleviation. In the past, local alcohol was an industry in its own right, and contributed up to 30% of household income. As the production of *embire* decreased in recent years, it affected the production of local drinks. Most of the *bibanja* that were traditionally known for having a lot of *mbire*, currently have nothing. This is vindicated by the lack of availability of local juice, local beer and local liquor. I interviewed a participant who had been making local liquor for more than 20 years. According to him, the decrease in *mbire* has affected his activities as he can only make liquor once a month, while in the past he used to make liquor every week. Another respondent who had a big *kibanja* with a lot of *mbire* revealed that the decrease of *mbire* on his farm has affected his farms earnings. He said that in the past it was possible to sell up to ten *mbire* per week, but nowadays sometimes it is difficult to sell even one *mbire* per week. It was further reported that in the past the income earned from the *kibanja* was often invested back into the same *kibanja* in order to increase its productivity. Using that income, it was possible to buy mulching grass, hire labourers and increase the herds of livestock for manure generation. After the decline of farm earnings, farmers are unable care for the *kibanja* like they were before. This contributes to a decrease in the productivity of the *kibanja* and ultimately community vulnerability.

### 5.2.3 Food price volatility

The decrease of productivity the *kibanja* has contributed to the skyrocketing of food prices in the study area. I personally observed this situation in the weekly markets at Bugorora and Magata villages, in which the price of most of the important crops such as banana, cassava, beans and maize was increasing quickly. During an interview with some of the businessmen at the Bugorora and Magata weekly markets, they blamed the problem primarily on unusual long dry spells, adding that price increase of food crops was just a small reason.

[26] Interview conducted on 28th September 2013 at Katanga village (Own translation)

Uncharacteristically low production of the crop following long dry spells and incidence of BXW disease in recent years has caused hikes in banana prices. The price of bananas during the time of this study stood at over Tshs 20,000 (8 Euro) per bunch, which was an incredibly large amount for the average banana customer. The increase of banana prices was causing it be seen as luxury food. One of the participants had the following remark on this issue:

> …….Imagine as said now the situation is the turning banana from staple food into a luxury Food. The price of this type of food is increasing daily. This is quite different with the past whereby bananas were abundant in all villages. Today, banana is becoming more expensive in restaurants than rice. Inevitably, the price will rise during the coming years, and hence we need immediate interventions to combat BXW disease. The government has to seek permanent solutions to such a devastating situation. However, the government should also not forget that BXW isn't confined to the *Hayaland* only; it has already reported in Kigoma Region and may even break out further to other banana growing regions. If there is no nationally coordinated strategies put in place, BXW disease will turn into a national disaster[27].

Another factor contributing to price volatility was the growing habit of smuggling food crops to Uganda and Southern Sudan. This business was growing and the high prices have tempted farmers to sell their crops to business men. Participants who partook in focus group discussion at Bugorora Ward stated that business men from Uganda and South Sudan were entering in the region specifically to buy Banana, beans, and other root crops. One of the participants was concerned after noticing that many local community members had started selling unripe bananas in bulk. He had the following remarks on this growing habit within the community:

> ……..most of the business men mostly from Uganda have their agents in this village who buy food on their behalf. These agents, who play a role of middlemen usually buy immature banana, sweet potatoes and cassava…..this is serious as farmers are lured to sell their crops without knowing what they will eat tomorrow. This could result into food insecurity as in the future people will not have enough food stock[28].

The above scenario indicates that the rise of food demand in Uganda and South Sudan has contributed to price volatility and ultimately the food insecurity. In such circumstances, rural poor people are more vulnerable as crops are being sold at unaffordable prices. Perhaps this is a golden chance for business men and farmers to make a fortune, but it undermines ordinary people who cannot afford even food cultivated on their own *kibanja*.

[27] Focus group discussion on 15th October 2013 at Kabingo village (Own translation)
[28] Focus group discussion on 25th October 2013 at Mbale village (Own translation)

### 5.3 Socio-cultural changes of the Haya

Many of the previously mentioned changes have resulted in socio-cultural changes within the community. In the past, the Haya community had a strong belief system, which included indigenous knowledge and practices that enhanced the adaptive capacity of communities in the face of any environmental uncertainty. In recent years however, the ability of the Haya to withstand environmental uncertainty has decreased. The evidence shows that, social and cultural aspects of the Haya, which in the past had contributed to underpinning the Haya indigenous knowledge, are less integrated into modern life. Consequently, the Haya people are becoming increasingly vulnerable to different on-going changes, particularly climate change. Some of the socio-cultural changes observed by the local communities include behavioural changes, the spread of Christianity, the decline of customary institutions and the decline of community solidarity.

#### 5.3.1 Behavioural changes

One of the most important aspects of the socio-cultural changes was the changes in the behaviour of community members, specifically among the youth. There is a widely perceived lack of respect among the youth toward elders within the community. The findings revealed that elders hold important roles within families and the community as a whole. They provide advice to the community regarding the use of indigenous knowledge in the face of environmental uncertainty. Elders decided what kind of agricultural practices should be used and were responsible for creating indigenous treatments for pests and diseases in livestock. Most of the participants during the focus group discussion felt that due to behavioural changes within the community it is difficult for youth to accept the advice given by elders regarding the use of indigenous knowledge in different activities. One elder gave the following remark regarding the conduct of the youths within the community:

> Nowadays it is difficult to direct my son to do what I want him to do especially when I advise him to use a certain indigenous based practice in farming activities….this is happening because the good behaviour among the youth has disappeared in recent years. Youths do not to take up what is being advised by elders. They usually tell us that our advice is outdated and too primitive….I think this is not right because in the past when I was young I could take up the advice given by my father or any other elder in this village. In those days every youth was obliged to respect any elder with the community. In recent years the situation has changed as most of the youths do not respect elders, even their parents……They usually do what they want but do not take up the advice of

> elders. As the result most of traditional practices of adapting to uncertainties seem inappropriate to them[29].

Interviews with the youth participants revealed that most of the youths respected the elders but found it challenging to accept their advice and recommendations regarding the use of indigenous knowledge in different activities. According to them, indigenous knowledge is outdated and cannot sufficiently adapt to various challenges, particularly recurrent environmental changes. Indeed, some of the youths who had used indigenous knowledge before, admitted that this knowledge was adapting too slowly and was not helpful as western knowledge.

### 5.3.2 The spread of Christianity and changes of indigenous belief systems

The Haya community is one of the most Christianized societies in Tanzania, and indeed, East Africa. These people have a long history of conversion, most of their kings were converted and became Christian early in the British colonial era (Stevens, 1991). The western Christian missionaries played an important role in the transformation of Haya indigenous belief systems. The inception of Christianity among the Haya community had negative consequences on the socio-cultural context of the Haya community. Before the inception of Christianity, the Haya people worshipped indigenous deities. They would often pray to their ancestral Gods during periods of environmental uncertainty, sickness, after the birth of the children, funerals, while going for hunting or fishing and at weddings (Kameli, 2007). The indigenous religious activities of the Haya often centred on role-specific deities, witchcraft, ancestral spirits, rites of passage and sorcery, providing a channel for the seemingly paradoxical expression of both evil and righteousness. Spirits and deities were known to have worshipers at various stages of worship. Masked dancing and animal sacrifice was a common medium for spirit possession and was central to the overall belief system of the Haya. Thus, the religion was an extremely important component of Haya culture (Rweyamamu, 2012). The Haya people use the names *Mulungu* (also sky or sun) to refer to all-powerful God. They also worship and recognize *Ishwanga* who they believe to be a supreme being, ever present creator, the almighty, the ruler of the earth and a heaven that rewards the good and punishes the wicked (Effiong, 2009). During a focus group discussion with an elderly group in Mbale village it was reported that, each clan had its own God to whom they would pray for solutions to their various problems confronted them. One respondent explained as follows:

[29] Focus group discussion on 30th September 2013 at Karutanga village (Own translation)

> Before the inception of the Christian religion in our community each clan had specific places for worshiping their Gods. My grandfather was a well-known medicine man in this village; he built a worship house behind his main house and people used to visit this shrine as a religious worship for many years until Christianity was introduced. People could visit this shrine to seek solutions to the various problems they encountered. Different clans in this village used to have their God in specific areas including under big trees called *emirundu* (which is connected with spirits) and bushes. These areas were commonly used as places of worship[30].

It was also reported during the focus group discussions in Magata Village that, the Haya considered ancestors as supernatural beings. However, ancestors were not worshipped, they were honoured by the members of their families. They were believed to be the living dead, as in their souls continue to exist after death and are part of the living community. In fact, the Haya believe those ancestors are always around when family members are eating (Kameli, 2007). Kilaini (1990) shows that ancestors among the Haya comprises of two categories namely "e*kizimu* and *muzimu*[31]. The difference between the two categories is that, while the *muzimu* (Ghost) are believed to be alive though they are dead. The *ekizimu* which is believed to be the soul that has not yet found the place to rest after death. The *ekizimu* is believed to be dangerous and evil since it has no place to rest and it can come back and cause harm to its relatives. To prevent that danger, the Haya bury their dead with some traditional herbs in order to make the dead person's spirit to rest" (1990, p.32-34).

Indigenous belief systems gradually started to lose popularity within the community after they were overwhelmed by contemporary belief systems. Currently, the religious beliefs of the Haya have changed and people are embracing western religions. Most Haya people have been converted to Christianity. A study carried out by Stevens (1991, p.3) in the Haya villages of Muleba District found that over 90% of the respondents declared themselves to be Christian: 32% were Catholic, 14% were Lutheran, and only 3% were Muslim. One household head was yet unbaptized, though his family members were Christians. Stevens (1991, p.3-4) observed:

> "Almost all households bore physical evidence of religious adherence in the form of visible symbols: mass-produced Catholic devotional items such as rosaries, pictures of the Virgin, the Pope, or Cardinal Rugambwa (a Haya of royal lineage and the first African cardinal), the Swahili Bible and pictures of the local Lutheran

[30] Focus group discussion on 1st September 2014 at Katanga village (Own translation)

[31] According to the *Haya* traditions people *Muzimu* is the soul of a dead person who passed away long time ago that can appear in invisible form or other manifestation to the living (A definition given by elderly person aged 76 in Kabingo Village).

> bishop in Protestant households, and Koran verses or pictures of Mecca in Muslim households. Religious images were the only form of decoration aside from a small number of family photographs in some households. All households reported specific amounts of money given as *sadaka* (offerings) to churches or mosques weekly"

The above testimony demonstrates that the indigenous belief systems of the Haya are waning. However, there are some local communities who still believe in both indigenous belief systems and Christianity together. Generally, Christianity has transformed the indigenous belief systems of the Haya, the community is completely overwhelmed with western belief systems and indigenous knowledge is increasingly delegitimized within the community.

### 5.3.3 Decline of customary institutions

Another important aspect of socio-cultural change of the Haya is the decline of the *Omukama and the Abagurusi* within the community. *Omukama* is the title given to the traditional ruler of the Haya. The *Omukama* and his administration were important in orienting the social life of the Haya and helping to preserve the traditional customs and taboos of the Haya. These traditional customs and taboos of the Haya were important in adapting to different environmental uncertainties. After colonial invasion, the administration of *Omukama* began to fall apart. After the collapse of *Omukama*s' administration, the colonial government took control until when the country got its political independence in 1961.

The decline of the *Omukama* paved the way for the emergence of another strong customary institution: the *Abagurusi*. The *Abagurusi* are a group of elders who play an important role in solving different problems within the community such as environmental uncertainties and personal conflicts within the community. Most of the activities undertaken by the *Omukama* administration before colonial invasion were implemented by the *Abagurusi*. They were responsible for implementing customs and taboos of the community, for example, in the event of a disaster such as drought, the *Abagurusi* would convene and initiate a cultural practice to bring in the rain. Many of the important traditional activities were carried out under large trees known as *emirundu*. In recent years, the *Abagurusi* is gradually becoming weaker. The disintegration of *Abagurusi* is largely due to interference from the state. The creation of state institutions such as the Village Government (*Serikali ya Kijiji*) has contributed to the decline of the *Abagurusi*. The establishment of Christianity within the Haya community also weakened the role played by the *Abagurusi* within the community. The traditional belief systems are slowly becoming less important. The decline of the *Abagurusi* institution in Buhaya is associated with an increase in environmental uncertainties, as most of

the traditional rituals are not currently being undertaken within the community. For instance, during the focus group discussion in Katanga village the participants linked the decline of the *Abagurusi* institution with existing environmental uncertainties within the community in the following manner:

> In case of environmental uncertainties such as drought, *Abagurusi* could convene under the *emirundu* and undertake important cultural practices, and this could bring the rain……they performed traditional rituals by giving sacrifices to the ghosts. Currently the community does not undertake all these cultural practices after the government and religious institutions have undermined *Abagurusi* institutions….this is the reason for all these problems[32].

The decline of customary institutions has led the community to cut down the *emirundu* to sell as the lumbers. It was reported that in each village there used to be at least 10 *emirundus* used by the local community to undertake different cultural practices. But in recent years it has become quite difficult to find these trees in some of the villages. This has negative effects on the efficacy of indigenous practices in reducing vulnerability. Alemu (2013) argues that undermining the social apparatuses which assist the community in reducing vulnerability increases the environmental uncertainties due to climate change. The decline of customary institutions within the study area has therefore, caused indigenous farming and livestock keeping practices to be eroded within the community. Currently, the majority of the local communities have replaced indigenous adaptation practices with modern adaptation practices proposed by the government and different NGOs.

### 5.3.4 Decline of community solidarity

It was reported during the focus group discussion that unity within the community has disappeared in recent years. In the past the community relied on its traditional practices to create a strong societal bonds and solidarity. Through this solidarity, it was possible for the community to handle different sources of vulnerability collectively. For instance, during instances of strong winds (*omuyaga*), which could destroy crops in the *kibanja*, community members would rally to contribute food and banana seedlings to assist the vulnerable household. When there was a death in the community, people could also contribute food to comfort the bereaved. Weddings also depended on community solidarity, as the father of the bridegroom was responsible for asking fellow villagers for *embire* in order to make local beer (*rubisi*) for the wedding of his son. This was a Haya custom and no one could refuse to give free *embire* for a wedding or any other special event. During weddings, all community

[32] Focus group discussion on 3rd September 2014 at Katanga village (Own translation)

members were invited to participate in the function even if they were not able to contribute. These communal events helped to solidify the unity of the village. However the situation has changed, people no longer ask for *embire,* instead they request cash contributions. Event attendance has now been restricted to only the people who contributed money for it, which have created classes in the community.

The lack of solidarity does not end at the community level but extends to the family also. During focus group discussions, local communities reported that tensions between family members have been on the rise. This situation undermines the collective actions that are taken at either the family or the community level to reduce vulnerability. The following quote reflects this sentiment:

> I was raised in a family and a community which had strong relationships and solidarity. People cooperated in solving different problems and rejoiced together during happy moments…currently family and community members do not have good relationships like in the past. I don't know the future of our children as we don't cooperate together and love each other. This contributes to the decline of family and community solidarity[33].

The increased poverty accelerated by poor productivity of the *kibanja* is considered to be the major factor for the vanishing of solidarity within the community. As a result of the lack of solidarity, every household undertakes measures to reduce vulnerability to climate change independently.

### 5.5 Environmental changes

Environmental changes particularly land degradation, soil erosion, and climate changes within the Haya community are becoming serious issues in recent years and are affecting community livelihood systems. According to the Missenyi District Environmental and Natural Resources Officer, the behaviour of local communities has been heavily contributing to land degradation over the last 30 years. One of the leading factors of this land degradation within the district is overgrazing. It was reported that in recent years there is a growing tendency among the keepers of large herds of cattle to graze livestock in a single place. Most of the livestock owners have the perception that owning a large herd of cattle is a sign of wealth, which causes them to try to increase their herd size, which only further degrades the land. Livestock owners sometimes also graze their livestock around water catchment areas and intensify degradation along water catchment areas. Extension staff members have been

[33] Focus group discussion on 1st November 2013 at Bugorora village (Own translation)

trying to solve this problem through awareness campaigns focusing on reducing the number of cattle.

Among the other underlying factors for land degradation were increased population, poverty and ignorance amidst the local communities. In Bugorora ward, the population was increasing too fast and put more pressure on the available resources within the village. This created a scarcity of agricultural land within the village to the extent that people started to engage in unauthorized farming. The data shows that existing populations cannot be supported by the available agricultural land. Several participants of focus group discussions mentioned that the population in the study area was increasing at uncharacteristic rates. This concern was presented in the following quote:

> …… when I was young the whole village had very few children. We could not exceed even fifty children in the whole village starting from Bushenya Sub-Village to Katoke Sub-Villages. In those days, we had only one ward primary school, and each class at that primary school had only one class. In recent years the population is increasing too fast, the ward primary school could not accommodate all the children in the community. The government created a strategy to establish new primary schools in each village and one secondary school in each ward. Currently, the number of new born is increasing too fast, as even the village primary school is unable to accommodate all children in this village alone. Each class has three sub-classes, this indicates that the population is increasing too fast in recent years[34].

It was further reported by the interviewees that recurrent land degradation was contributing to the depletion of vegetation cover. This has affected the local community as it is difficult to get access to various forest products such as fire wood and building poles. During the focus group discussions, the majority of the participants were of the opinion that a lack of access to fire wood was a big problem within the community. From what was observed, it seemed that the depletion of vegetation cover was also a persisting issue in the study area because of an overdependence on fire wood as their main source of energy and the increasing demand of building poles. Currently, many of the houses currently being constructed in the study area use a very large amount of poles and timber, when compared to the simpler houses of 30 to 40 years ago which contributes to the depletion of forests in the study area. This observation is confirmed by the Ward Executive Officer (WEO) of Bugorora:

> In recent years there is a growing demand for timber for house construction in this village. The growing demand for timber has accelerated the rate of deforestation. In the past, most of the traditional houses in this village were constructed with

[34] Focus group discussion on 2nd September 2013 at Katanga village (Own translation)

poles and thatched roofs. But in recent years there are modern houses constructed with bricks and a lot of timber, which triggers deforestation[35].

Soil erosion is another environmental problem in the study area, which if not controlled soon enough, is going to be even more serious in the coming days. The majority of the participants of focus group discussions in Katanga and Mbale villages expressed their concerns about recurrent soil erosion. The local opinions on the causes of soil erosion in the study area mostly focused on the increase of uncontrolled grazing and farming especially along the river banks of the Ngono River. It was also found that most youth work in brick making and stone quarrying due to the persistent failure of agriculture activities in the area. This in turn has triggered severe soil erosion in the areas were those activities are undertaken. This situation suggests that measures to curb soil erosion are urgently needed in the study area.

**Figure 15: Different human activities which cause soil erosion**

***Source*: *Fieldwork (2014)***

[35] Interview with Bugorora WEO on 5th October 2013 at ward office (Own translation)

Another important aspect of environmental change in the study area is climate change. Climate change has posed tremendous challenges for the local communities in the study area. It was widely reported by local community members that there have been significant changes in the average weather in recent years. Indeed, the participants of focus group discussions in all the study villages reported that long dry spells and shifting of the rain patterns have been occurring regularly in recent years. It was stated during focus group discussion in Karutanga that long dry spells are not a new phenomenon in the local communities, but in recent years the magnitude of these events has increased when compared to the past 30 years. Where in the past, long dry spells used to occur every decade in the area, in recent years long dry spells occur every year. Muleba DAO had the following remarks:

> Particularly, for the last 8 years we have seen more recurrent and long dry spells. Repeated long dry spells contributes to moisture stress leading to crop failure. For example, long dry spells prevailed in the years 1997/1998, 2003/2004, 2006/2007, 2011/2012 in this area and caused a decrease of food production and an increase in food insecurity[36].

Moreover, it was reported by the participants that there was shifting rain patterns in the study area. The rains were not merely inadequate but unpredictable, making it difficult to plan and undertake livelihood activities. For example, the 2006/2007, rains were insufficient for the whole year in the study area. These dry spells have resulted in the failure of agriculture production and wide spread malnutrition caused by a scarcity of indigenous bananas. The onset of rains has been changing from season to season in the study area. The findings depicts that in recent years it is difficult to follow a traditional planting calendar due to the inconsistent onset of the rain season. This quote from the WEO of Magata explains the situation as follows:

> In recent years the onset of rain is unpredictable, this contributes to seasonal changes, in which we have unexpected and unreliable rains….the agriculture undertaken by the community is rain fed. Thus, insufficient rains greatly affect the local communities. Very few local communities are able undertake low scale irrigation farming, especially to new crops, which were not practiced before such as horticulture and upland rice farming. Generally, seasonal changes have lowered the production of food crops and cash crops in this village over the last ten years[37].

Climate change has become the greatest environmental challenge facing the local communities in the study area today. However, the findings in this study have shown that climate risks intersect with other risks in the study area to produce impacts, which affect the

[36] Interview with Muleba DAO on 29th September 2013 at district council office (Own translation)
[37] Interview with Magata WEO,

livelihood activities of the local communities. From this perspective, climate change should be placed at the centre of any vulnerability analysis in the study area.

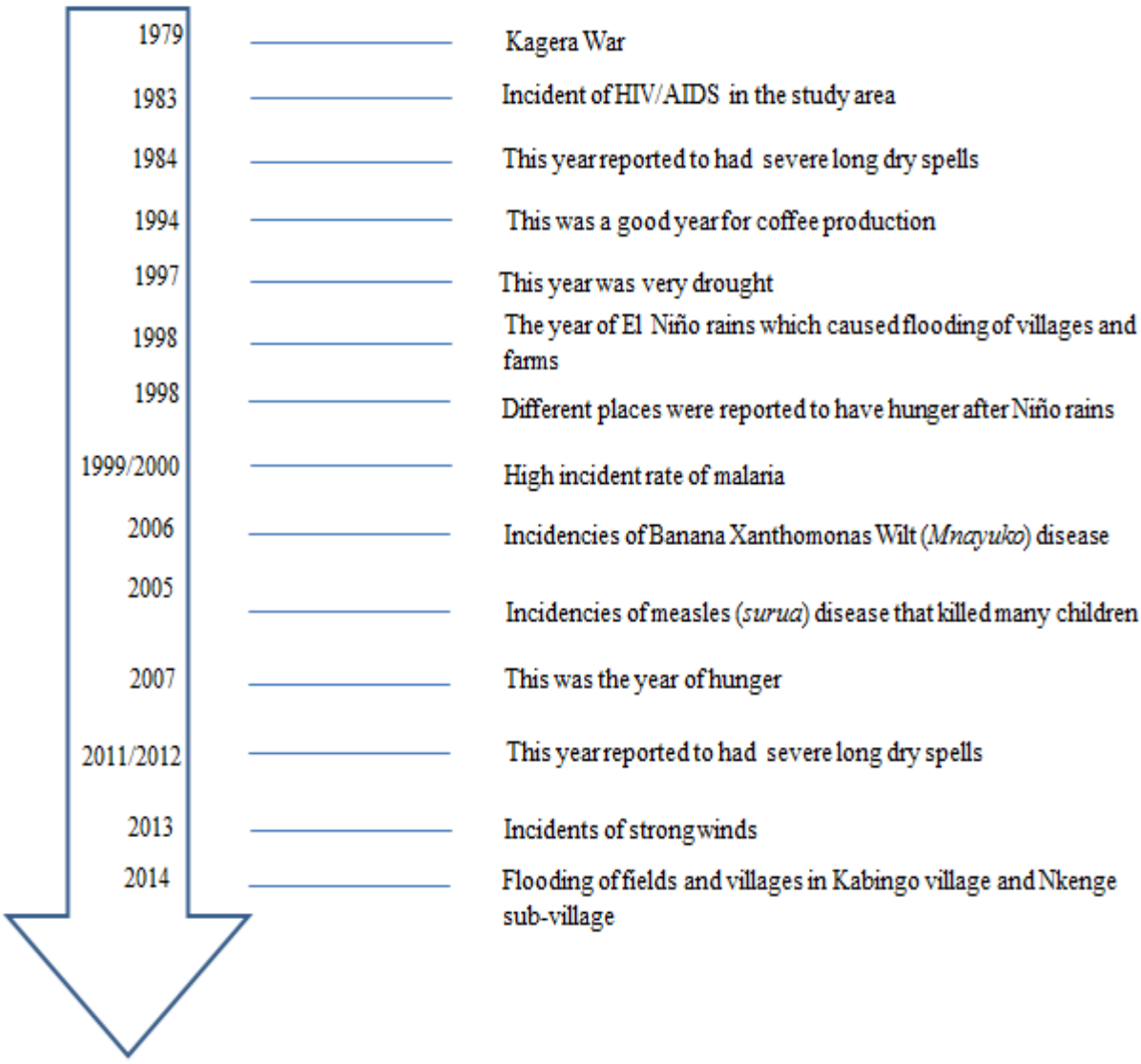


**Figure 16: History timeline of the major socio-ecological events in the study area**

***Source:*** *Fieldwork (2014)*

### 5.6 Interim Conclusion

In this investigative chapter, I have shown how different on-going changes contribute to community vulnerability. The purpose of this chapter was to demonstrate that community vulnerability in the study area is not caused only by climate change, but is the result of many of on-going changes, which interact together to produce impacts. Furthermore, other on-going changes in the area have undermined the ability of the local communities to adapt to

climate change risks. Using the starting-point vulnerability approach, I have tried to analyse different non-climatic factors and social processes that constrain the local community's adaptive capacity and coping strategies in dealing with climate change risks (cf. 2.7). As illustrated by Chambers, " vulnerability exists even in the absence of particular physical hazards, the broader socio-economic conditions that impede or facilitate people's strategies should be at the centre of analysis in starting-point vulnerability. Thus, vulnerability happens at the convergence of 'external risks and stresses' and internal conditions that subsume lack of people's capacity to respond to and cope with damaging loss" (1989: 1).

With different on-going changes such as climate change and incidences of banana disease, the production of crops has decreased in the past 30 years. Accordingly, the production of indigenous bananas, the main staple food among the Haya has been tremendously reduced. The government has been undertaking various initiatives to reduce vulnerability such as the *Kilimo Kwanza* initiatives as one of the sectoral responses to climate change. Although *Kilimo Kwanza* seeks to attain high levels of agrarian mechanization that is hoped to transform small-scale farmers into commercial farmers, this initiative has caused huge tracts of land to be taken by large-scale farmers. The majority of local community members who are small-scale farmers have been left with small portions of land. This initiative undermines the ability of the local community to respond to climate change risks. For instance, before the inception of *Kilimo Kwanza* it was possible for the local communities to extend their farming and grazing activities to the grassland during long dry spells. After the onset of the *Kilimo Kwanza* initiatives, that option is no longer available, as most of the grasslands have been leased to individual investors,

The problem of land shortages was exacerbated by the *Kilimo Kwanza* initiative that operates under the canopy of the green revolution and continuously encroaches on the grasslands (*rweya*) and wetlands of the local communities inhabiting the Ngono River Basin. This confirms the fact that, local community vulnerability in the study area also is contributed to by market forces, poor state policies, reduced productivity, market access problems, changes in the socio-cultural fabric and climate change. This is extremely significant as, the Haya were entirely dependent on farming and livestock keeping for centuries. With these changes, the Haya have started to engage in alternative livelihood activities and use their indigenous knowledge to adapt to the vulnerabilities. These adaptation strategies will be discussed in detail in the subsequent chapters.

# Chapter Six

## Making Sense of Climate Related Risks at Community Level

> I fail to understand what has happened because there is no right answer regarding what causes long drought seasons and late onset of the rain season. Perhaps experts may have appropriate answers on what is happening ….in the community there are different perspectives. In my view, I think this is the will of God, God is above everything. He may decide what should happen or not to happen[38]. - Mbale Village Elder

Before exploring how the local communities adapt to climate change risks using indigenous knowledge, it was imperative to get a picture of the perceptions of the local communities and other stakeholders regarding the state of the local climate. The local communities in the study area may not understand the concept of climate change, but they feel and observe its effects. Thus, this chapter focuses on the main three elements of weather as perceived by local communities: rainfall, temperature and wind. These three elements of climate are crucial for livelihood activities and thus, for the local community's survival. The different socio-economic impacts of climate change will also be discussed in this chapter as they are very important in understanding the rationale behind the adaptation practices to climate change risks undertaken by the local communities. The presentation of the findings on the state of the climate will not only show what precisely local communities perceive about the existing climate changes in, but will also serve as a crucial foundation for the next chapters of this study. Quantitative as well as qualitative data will be presented to reflect how local communities in the study area make sense of local climate change.

### 6.1 Local community's knowledge and perceptions about climate change

Climate change is among the many drivers of change which contribute to community vulnerability. Its impacts cannot be isolated from the multiple agricultural, economic, socio-cultural and environmental changes facing the local communities. These impacts intermingle, creating exacerbating and cascading effects. This section attempts to identify how local communities in the Ngono River Basin perceive and explain their local climate conditions. Their perceptions are relevant as they indicate and predict the state of the local climate in the future, by considering their information access, local experiences and indigenous knowledge.

[38] Interview conducted on 10th November 2013 at Mbale village (Own translation)

Perception has a very strong impact on adaptation measures at the individual or community level (Maddison, 2006). It affects the specific nature of their behavioural responses, and shapes adaptation options, processes and outcomes (Pauw, 2013, p.270). Therefore, understanding the local community's perception of their local climate is important since it raises individual cognition (Grothmann and Patt, 2005, p.205) regarding the ways he/she should adapt hence, this enhances adaptive capacity (Smit et al. 2001). For rural households, perceptions of local climate change helps them to make decisions to change their daily practices in order to adapt to climate change risks (Ndaki, 2014). Thus, any misconceptions on climate change and its related risks may result in no adaptation or maladaptation which can increase the negative impact of the changing local climate (Grothmann and Patt, 2005). The following sections present different perceptions of the changes in local climate from local community members. Different methods were used to collect information regarding local perceptions including questionnaires, focus group discussions and interviews.

### 6.1.1 The questionnaire

About 39.9% of surveyed respondents from all the study villages reported knowing very little regarding climate variability and change, whereas 29.2% of the respondents know about climate variability and change. Only 11% reported knowing a lot regarding climate variability and change. This group of respondents had broad knowledge regarding climate variability and change. The figure 17 further depicts that a significant proportion (19.9%) of the respondents do not know about climate variability and change at all. This limited knowledge of climate change could be due to the lack of access to scientific information on climate variability and change. This in turn could be attributed to an insufficient amount of extension staff in the study area. Most of the survey villages had no extension staff. This ignorance has contributed to the local community's inability to adapt to climate variability and thus, the poor agricultural yields. Those who knew a lot and knew little reported to have heard information about climate variability and change from media such as radio and newspapers. Some reported to have been informed by the elders within the community who had insight on the changing environment, while others were informed by awareness campaigns undertaken by local NGOs.

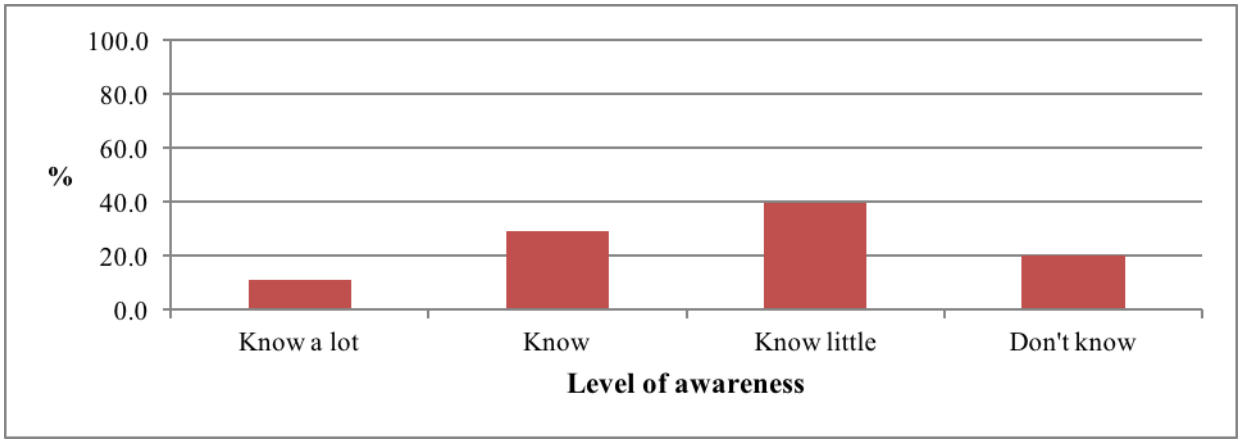


**Figure 17: Level of awareness of climate variability and change of the community**

***Source***: *Fieldwork (2014)*

The questionnaire data shows that local communities had different, mostly negative, perceptions regarding the state of local climate within that timeframe. This study focused on the local climate changes that had been occurring over the last 30 years. It was reported by the respondents that within this timeframe many changes were noticed, including: decreased rainfall, shorter rainy seasons, later onset of rains in year, increasing numbers of strong wind events, and unusually rapid increases of temperature. Table 1 and Figure 18 show the results from the questionnaire in frequencies and percentages respectively.

**Table 1: Local community's perceptions of the state of local climate**

| Local Perceptions | Karutanga (N=48) | | Katanga (N=56) | | Magata (N=49) | | Bugorora (N=53) | | Kabingo (N=42) | | Mbale (N=43) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No | Yes | No |
| Increasing rainfall amount during rain season | 0 | 48 | 1 | 55 | 1 | 48 | 2 | 51 | 0 | 42 | 0 | 43 |
| Decreasing rainfall amount during rain season | 47 | 1 | 56 | 0 | 49 | 0 | 52 | 1 | 42 | 0 | 42 | 1 |
| Increasing length of rain season | 0 | 48 | 0 | 56 | 0 | 49 | 0 | 53 | 0 | 42 | 0 | 43 |
| Decreasing length of rain season | 46 | 2 | 55 | 1 | 46 | 3 | 49 | 4 | 40 | 2 | 43 | 0 |
| Early onset of rain days | 2 | 46 | 3 | 53 | 5 | 44 | 16 | 37 | 7 | 35 | 9 | 34 |
| Late onset of rain days | 47 | 1 | 53 | 3 | 43 | 6 | 43 | 10 | 32 | 10 | 36 | 7 |
| Increase of strong winds events | 45 | 3 | 53 | 3 | 47 | 2 | 50 | 3 | 39 | 3 | 36 | 7 |
| Increasing temperature of the area | 48 | 0 | 56 | 0 | 49 | 0 | 53 | 0 | 42 | 0 | 43 | 0 |
| Decreasing temperature of the area | 0 | 48 | 0 | 56 | 0 | 49 | 0 | 53 | 0 | 42 | 0 | 43 |

***Source*:** *Fieldwork (2014)*

(*Multiple responses were possible*)

The data showed that 99% of the respondents were of the opinion that rainfall had been decreasing over the last 30 years, while only, 0.7% felt that it has been increasing. About 95.9% of respondents felt there had been shorter rain seasons, and 87.2% perceived that the onset of rain was abnormally late than it used to be in the past 30 years. As for strong wind events, 92.8% perceived that they had been increasing. However perhaps the most significant figure was that all respondents (100%) perceived unusual increases in temperature compared to previous decades. Details are presented in Table 6.1 as well as Figures 18.

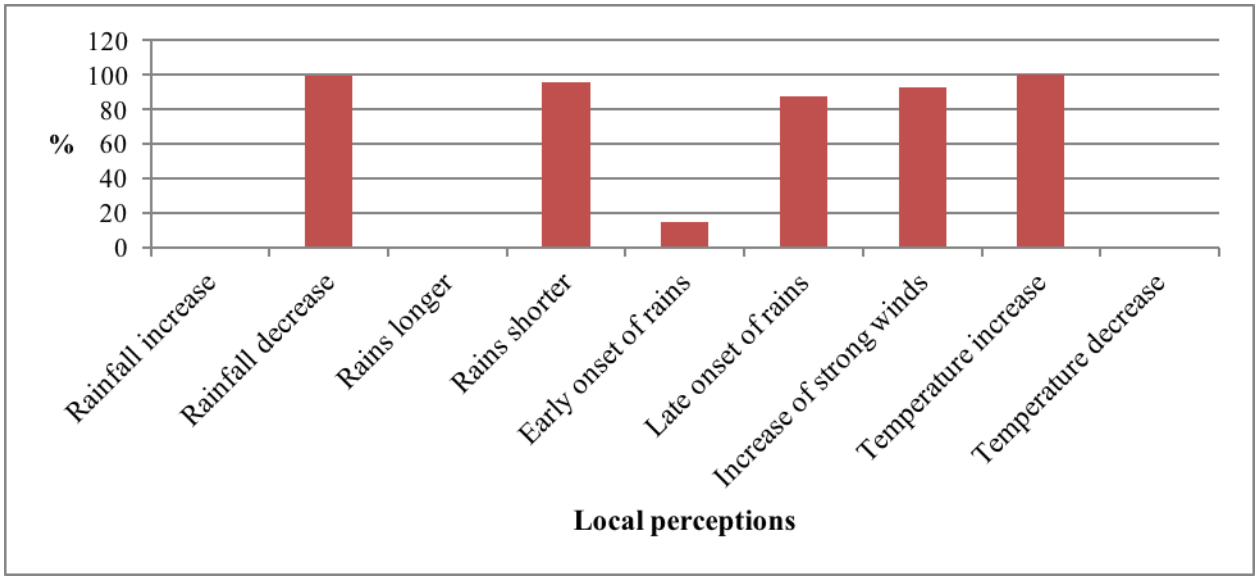


**Figure 18: Local community's perceptions of climate change**

***Source*:** *Fieldwork (2014)*

(*Multiple responses were possible*)

***Local community's perceptions at village level***

The general overview of the local community's perceptions at the village level is presented in Table 1 and Figure 19. Generally, village results indicated no major differences from the general summary on the changes of the state of local climate (as illustrated in Figure 18). Nearly all the perceptions from the questionnaire data showed similar trends at the village level. It is significant to note that the majority of respondents from all villages (97.9% for Karutanga, 98.1% Bugorora, 100% for Katanga, Magata and Kabingo, and 97.8% for Mbale) felt the rainfall amount was decreasing. However, the data indicated that over 90% of the farmers from six villages, that is, 95.8 % from Karutanga, 98.2% from Katanga, 93.9% from Magata, 100% from Bugorora and Mbale respectively, as well as 95.2 % from Kabingo perceived that the rain seasons were becoming shorter. Local communities also reported that onset of rainfall has shifted, as 97.9% of the respondents from Karutanga, 94.6% from Katanga, 87.8% from Magata, 81.1% from Bugorora, 76. 2% from Kabingo and 83.7% from Mbale were of the view rain is now abnormally late. Regarding the incidents of strong winds, local communities indicated that strong wind events are increasing with the following data: 93.8% for Karutanga, 94.6% for Katanga, 95.9% for Magata, 94.3% for Bugorora, 92. 9% for Kabingo and 83.7% for Mbale. Concerning the state of temperature, all respondents

expressed views that it has been increasing for the past 30 years. The results of perceptions by villages are illustrated in Figure 19.

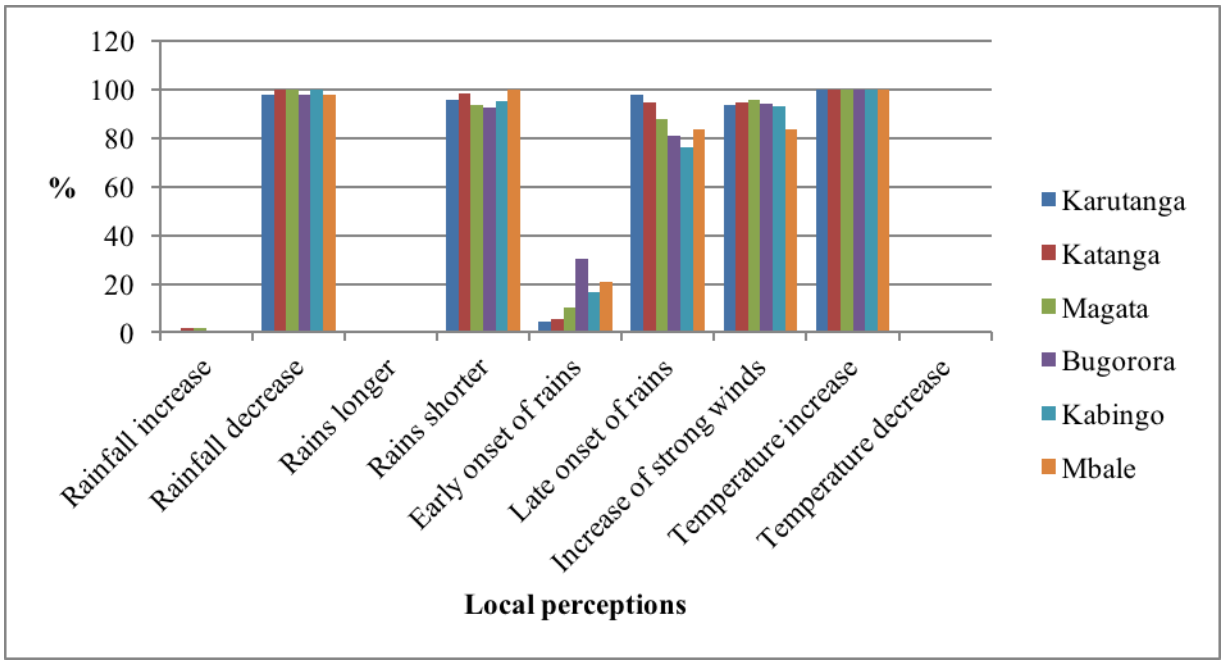


**Figure 19: Local community's perceptions of climate change at village level**

***Source**: Fieldwork (2014)*

(*Multiple responses were possible*)

### 6.1.2 Focus group discussions and interview narratives

Most of the interviews with local communities supported the data from the questionnaires regarding the changes in local climate over the past 30 years. The findings revealed that there were changes in the local climate, though with slightly different elucidations on reasons related to those perceived changes. The changes that were most frequently mentioned by the interviewees were related to rainfall and temperature trends, strong winds and flood events in the area.

***Local perceptions of temperature changes***

The qualitative information largely coincides with the information collected through questionnaire surveys. Most of the respondents had the view that temperatures in the study

area were increasing at an unusual rate compared to the past 30 years. The following remarks underpin this argument as follow:

> In recent years, temperatures have increased compared to the past 30 years….in the past we had more cool months than warm months. In recent years, warm months have increased compared to the cool months. For example, it was difficult to have extremely warm condition during this month of September as this month was the coolest month. The weather in this month has changed and we cannot use blankets to protect our body while sleeping tonight anymore, because it is extremely hot this time around. This has disappeared in recent years[39].

> This is the most surprising weather I ever underwent before in this village. In the past this month of September and the last month of August were the coolest months. Most of time you could find people wearing pullover sweaters and jackets to protect their bodies against cold weather….things have changed for the past 30 years as it is not even possible to stay inside the house during the afternoon…the weather is too hot[40].

These temperatures increases are not evident only in the study area but throughout Tanzania. A study by Kangalawe et al. (2011) in the Great Ruaha River Catchment Area indicated that the temperature was increasing in the area to the extent that people did not need to use blankets to protect themselves from the cold at night. It was reported by one of the research scientist that in the Southern Highland area of Tanzania the temperature was increasing at an unusual rate. In the past this area had been characterized by cold weather.

> In the Southern Highland of Tanzania the temperature is increasing beyond what it was in the past 30 years. For example, in the past during cold months, different streams would freeze and had ice particles during morning hours because of cold weather. Currently there is no stream that is freezing in the Southern Highland of Tanzania. This indicates that the temperature has increased[41].

In some instances, respondents felt that the weather had grown more unpredictable. For example, in Magata, some of the respondents stated that 30 years ago, it was possible to predict the weather of the following day as there were specific periods for certain temperatures and rainfall levels, but that weather forecasting had now become complicated in the area. One of the interesting quotes forms the basis for this argument in the following manner:

[39] Focus group discussion with farmers on 19th September 2013 at Magata village (Own translation)
[40] Interview conducted on 10th October 2013 at Bugorora village (Own translation)
[41] Interview with a research scientist on 2nd August 2014 at the University of Dar es Salaam (Own translation)

> ….in the past when there was high temperature (*jua kali*), this was an indication that the following day it would rain, but nowadays when it is extremely hot, then the same weather condition will exist in the next day. This situation attests to how the recent weather conditions are unpredictable[42].

### *Rainfall changes*

Concerning the state of rainfall, respondents expressed concern that rainfall has been decreasing, and there has been a shift in the onset and distribution of the rains within the seasons. The data shows that rainfall is decreasing in the area compared to the past 30 years. It was revealed during interviews and focus group discussions that the decrease in rain has affected agricultural activities. The following quote from an interview supports this view:

> Recently there have been scarcities in rain compared to the past 30 years. Now we have planted beans and maize but as you can see it is not raining. There is a great decrease in the rainfall amount compared to the past when I was young. In the past, there were two rain seasons namely; short and long rain season (*omusenene* and *etoigo*). During both seasons rains were enough to enable crop growth. But in recent years, the rainfall amount has decreased and it is inconsistent, even our agricultural activities are greatly affected[43].

According to local communities in the past there were rain periods almost in every month, and each rain had a particular function. For example, when it was raining in June the purpose of these rains was specifically to enabling pasture regeneration after the prolonged dry season. Therefore, those rains were important for the survival of livestock such as cow, goat and sheep. The name given to these rains was called *myoyo ya nte* in the Haya local language (literally meaning the 'souls of cattle'). The rains in August were called *izimbya mazi* specifically for specifically for coffee inflorescence (*orwakyo*). From September to November was the short rain season (*musenene*) specifically for farm preparations, planting beans, maize and banana. In November to December there were rains called *ekito* specifically for the maize growth. In January, there were rains known as *akato* also for maize growth. From March to May there was a long rain season (*etoigo*), whereby people would plant new bananas. Currently, those rainfall periods have changed to the extent that it has completely distorted the Haya agricultural almanac. The time when this study was carried out it was supposed to be the period of the short rain season, but surprisingly but it was not raining and crops were drying due to moisture stress.

[42] Interview conducted on 20th September 2013 at Magata village (Own translation)
[43] Interview conducted on 3rd September 2013 at Katanga village (Own translation)

The DAOs from both districts (Missenyi and Muleba) have confirmed that there are changes occurring in terms of the amount of yearly rainfall, its distribution throughout the year and its onset. This made it difficult for local communities to make decisions about planting dates. In the following remark, one official explains that:

> ……the onset of rain has been changing in recent years. This district is categorized into different ecological zones, the important zone is where Ngono River starts, whereby in the past this zone had enough rains from the middle of August to December. In recent years the situation has changed, the onset of rain is not in August anymore. Sometimes, it may happen that the rain starts at the beginning of August and the community starts preparing their farms then after one week the rain stops. This time people have already planted their crops but we have more than three weeks without rain and crops are undergoing moisture stress. There are also incidences of late rains, in which, instead of starting in the middle of August, the rains may start around the beginning of October. This situation perplexes the community as the planting dates cannot be precise[44].

Regarding the rainfall length, it was reported by several respondents that the long rain season, which was supposed to last three months from March to June, has decreased drastically in recent years. It is now common for these rains to last only one month. This was perceived by local communities as the main reason for the crop failure. For example, one of the older respondents made the following comment on this issue:

> The discussion about changes on the state of the local climate reminds me of those good years of the1960s until the late 1980s. During those good years, the length of the seasonal rains was good enough. The short rain season started from the middle of August until around November, during this time we were able to plant different crops such as beans and maize. During long rain seasons rainfall started from March until early June. Rainfall was not a problem during these periods. But nowadays this is not the case. No one is exactly sure how long the rain will last. Its length is unpredictable and everything is difficult[45].

In a similar note, the WEO of Magata-Karutanga had the following remarks regarding rainfall changes in the area:

> Since I was born in this district and come to work in this village, I can easily see that the climate of this area has changed to greatly over the past 30 years. Currently, rainfall is unpredictable and in most cases it comes very late and lasts only for a short time. Such rains cannot help the local communities undertake their farming activities. The rivers of Nshorongo and Bushenya, which used to flow throughout the year, are now only flowing occasionally[46].

[44] Interview with Muleba DAO on 10th September 2013 at district council office (Own translation)
[45] Interview conducted on 30th September 2013 at Karutanga village (Own translation)
[46] Interview with WEO on 31 August 2013 at Magata ward office (Own translation)

Apart from the information collected from interviews, the data from focus group discussion reinforced the local community's perceptions on the rainfall changes. This was due to the fact that the local community's agricultural system is rain-fed. Thus, to them rainfall availability is important in ensuring agricultural production. One important quote on the changes of rain fall was given by an older respondent in Karutanga:

> Basically, the climate of the village was very good. 30 years ago, the condition of the village was quite encouraging with good harvests from the *kibanja* and plentiful rain. During those days of which I refer as the good years, food was abundant within the village. We could sell our surplus banana to Muleba even to traders who were coming to buy indigenous banana in the village. Generally the harvesting was good throughout the year. The situation started to change from early 1980s until now, the productivity of *kibanja* has decreased due the shortage of rains, but sometimes becomes better when there is more rain. As the rainfall keeps decreasing, the situation becomes worse than previous years. We are completely confused[47].

This explanation indicated that while the decrease of the productivity of the *kibanja* can be influenced by many factors some of which may not necessarily be associated with climate change. However, local communities perceive that the local climate has changed, because the productivity of the *kibanja* they used to see during good years are somehow improved during rainy season and disappear a short while after that.

***Incidences of strong winds***

Regarding the state of strong wind events (*omuyaga*), various perceptions and views expressed concerns that these wind events had been increasing over the past 30 years. The majority of the participants in the focus group discussions had the perception that the incidents of strong winds were increasing. The following quote reflects this sentiment:

> As for the incidents of strong winds, according to my experience and in my view, it is increasing. In the past we could face incidents of strong winds after many years. But nowadays almost every year we face strong winds events. Strong winds usually damages properties such as houses and crops within the *kibanja*[48].

In some of the instances, the decrease in the *emirundu* trees in various villages was viewed as evidence for the increase in strong wind events. In Katanga and Mbale villages, some of the respondents stated that 30 years ago, there was an abundance of large indigenous trees within the village which acted as wind barriers against of incidents of strong winds. As those trees

[47] Focus group discussion with farmers on 25th September 2014 at Karutanga village (Own translation)
[48] Interview conducted on 27th September 2013 at Karutanga village (Own translation)

continue to decrease due to deforestation, local communities are increasingly exposed to recurrent strong wind events, which able to cause more damages to crops and property.

### 6.2 Local perceptions on the causes of climate change risks

One of the crucial parts of the second research question for this chapter (see pg. 45) was to understand the way local communities explain the perceived changes in climate including the underlying factors, which they themselves consider to be behind those perceived changes. On this subject, different perspectives and explanations were recorded. The majority of the respondents provided scientifically proven causes of climate change risks. These causes were associated with human causes and included environmental degradation, pollution from industries, deforestation and modernization. However, a significant number of respondents provided non-scientifically proven causes of climate change risks. Most of the cited causes were aligned to supernatural forces, which included disobeying God's ten commandments, disrespecting of ancestral spirits and other traditional customs caused climate change. Other respondents related the causes of climate change with the state policies, in which local communities were blaming the government for forcing them to apply fertilizers, causing negative effects on the atmosphere.

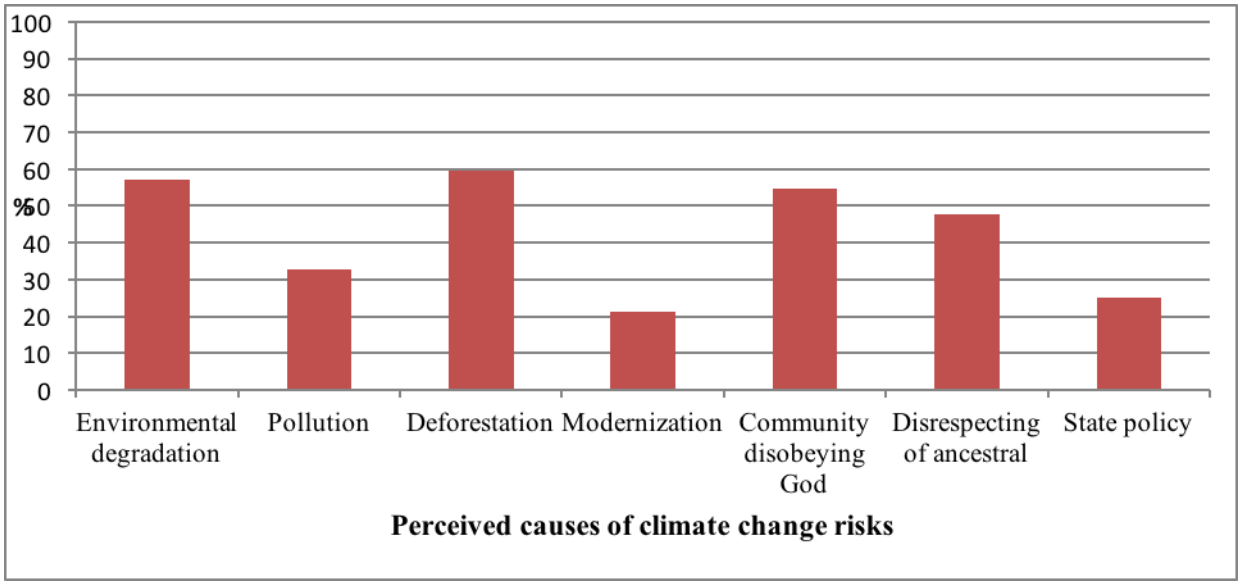


**Figure 20: Summary of the causes of climate change risks**

***Source***: *Fieldwork (2014)*

(*Multiple responses were possible*)

### 6.2.1 The questionnaire

Figure 20 shows local perceptions of the causes of climate change in the study area. Most of the respondent listed scientifically proven causes of climate change risks. More than half (59.5%) of the respondents perceived deforestation as the cause of climate change risks. About 57% of the respondents felt that climate change risks are caused by environmental degradation. About 32.6% of the respondents perceived that persisting air pollution from industries is the cause of climate change risks in the study area. While 25.1% of the respondents in the area reported that the poor state policy was the cause of climate change risks, 21.3% of the respondents perceived modernization to be the cause of climate change risks. However, a significant portion of respondents felt that there were supernatural causes of climate change risks. 54.6% of the respondents believed that, the increasing tendency of the community to disobey God was the cause of climate change risks. 47.8% of the respondents reported that the failure to respect ancestral and traditional customs as well as taboos was the cause of climate change risks in the study area.

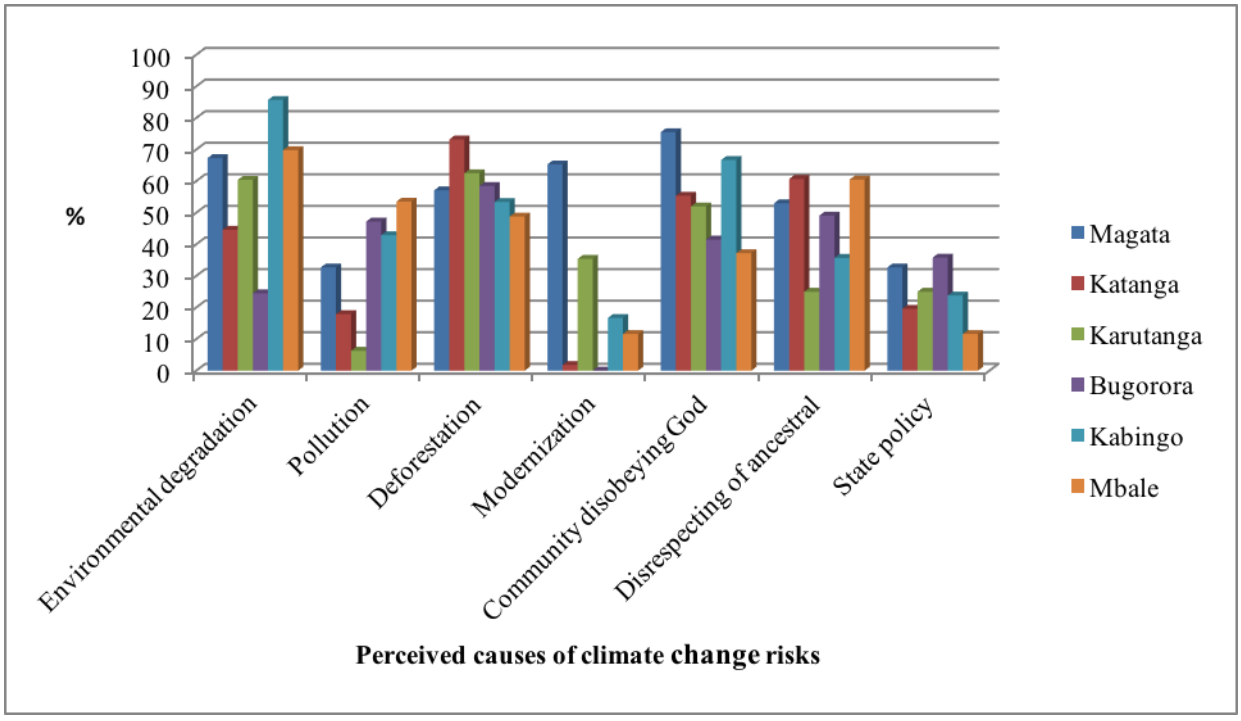


**Figure 21: Summary of the causes of climate change risks at village level**

***Source*: *Fieldwork (2014)***

(*Multiple responses were possible*)

As indicated in (Figure 21), the general views of the causes of climate change risks at village level are no different from the general summary of the causes of climate change risks in the study area. It was revealed that 85.7% of the respondents for Kabingo, 69.8% for Mbale, 67.3% for Magata, 44.6% for Katanga and 24.5% for Bugorora were of the opinion that environmental degradation was causing climate change risks. However, the data indicated that almost over 50% of the respondents from five villages, that is, 57.1% for Magata, 73.2% for Katanga, 62.5% for Karutanga, 58.5% for Bugorora, and 53.4% for Kabingo, had the view that deforestation is causing climate change risks. Apart from deforestation, it was also reported that air pollution was contributing much to climate change risks. The percentage of agreement with this claim was 53.5% for Mbale, 47.2% for Bugorora, 42.9% for Kabingo, 32.7% for Magata, 17.9% for Katanga and 6.3% for Karutanga. Interestingly, the pace of development for modernization was blamed for climate change risks by local community members in the study area. 65.3% of the respondents from Magata, 1.8% for Katanga, 35.4% for Karutanga, 16.7% for Kabingo and 11.6% for Mbale expressed concerns that the pace of modernization in recent years has triggered climate change risks in their villages.

Other respondents were not satisfied with some of government policies or with government leaders who had failed to enforce environmental policies and regulations for conserving the environment. It was reported that poor state policies, such as forcing communities to adopt agricultural technologies including fertilizer application and improved seeds contributed to climate change risks. According to local communities, the addition of synthetic fertilizers tends to disturb the weather condition and ultimately cause climate change risks. The percentages of agreement with this claim was 32.7% for Magata, 19.6% for Katanga, 25% for Karutanga, 35.8% for Bugorora, 23.8% for Kabingo and 11.6% for Mbale. Concerning the non-scientifically proven causes of climate change risks, more than a half (75.5%) of the respondents in Magata village, 55.4% for Katanga, 52% for Karutanga, 41.5% for Bugorora, 66.7% for Kabingo and 37.2% for Mbale were of the view that the increasing habit of disobeying God is the cause of climate change risks. Connected to that, other respondents had the feeling that failure to respect ancestral spirits and other customs caused climate change risks. This was reported by 53% of the respondents in Magata, 60.7% for Katanga, 25% for Karutanga, 49.1% for Bugorora, 35.7% for Kabingo and 60.5% for Mbale. All causes of climate change risks are presented in detail using qualitative data bellow.

### 6.2.2 Focus group discussions and interview narratives

The data collected from the interviews with local community members, research scientists, and experts, supported the findings from questionnaire surveys. The findings indicated that the majority of the respondents attributed the causes of climate change risks to supernatural forces such as disobeying of God and lack of respect to ancestral spirits. However, a few local community members, research scientists and experts associated climate change risks with human causes, such as environmental degradation, air pollution, deforestation, modernization and state policy.

***Human causes of climate change risks***

Across all six villages, with the exception of the older population in all villages, deforestation was repeatedly mentioned by the participants as the cause of climate change in the study area. It was reported during focus group discussions that people have severely reduced the amount of indigenous trees, which had been abundant in the village. Those big indigenous trees (*emirundu*) had the ecological functions of modifying the local climate by attracting more rains to the area. Thus, the increased deforestation in the study area is perceived by local communities to have caused shortage of rains in recent years. One of the female participants during the focus discussion had the following remarks:

> ….the decrease of rains is sometimes caused by ourselves because we are cutting trees excessively. In our village, we had big trees which were helpful in regulating the climate……if you have time to move around the village all the big trees like *emirundu* have been cleared….I think the decrease of rains and changes of rain seasons is happening due to deforestation. Thus, rain formations cannot take place, this is according to experts, but also we can observe this situation by comparing with the past climate when the village had dense and thick forests, which helped to bring us rains throughout the rain seasons[49].

Apart from scarcities of rains caused by deforestation, another elderly participant in the same focus group discussion associated the deforestation of indigenous trees with a decrease in soil fertility in the study area; he had the following to say:

> People cut down trees especially indigenous trees without planting the same trees. People now have increased the speed of planting non-indigenous tree species such as pines, which are not environmentally friendly. The deforestation of indigenous trees like *mijuju*, *mishambya*, *mihumura* and *mijuna* has contributed to the

[49] Focus group discussion with farmers on 10th November 2013 at Mbale village (Own translation)

> decrease of soil fertility. This is because the leaves from indigenous trees would fall down and decomposes, thus increasing the fertility of the soil[50].

This increased deforestation was a result of the difficult economic situation facing the community. People have been forced to sell the large indigenous trees in order to earn money. It is from this perspective that one elder had this to say:

> All large indigenous tree species have been cleared for commercial purposes. In this village, large trees like the *emirundu* were used by the local communities for worship and asking for deliverance from ancestral ghosts. Our grandparents used to give sacrifices of various things under these trees such as goats and local beer (*rubisi*). At present such kind of worship does not exist as all big trees have been cleared mostly for commercial purpose[51].

Local communities and other stakeholders, who participated in the interviews and focus group discussions, also emphasized the issue of environmental degradation as the cause of climate change risks in the study area. Local community members stressed that increased human activities along water catchments areas were threatening the availability of water resources in the area. It was revealed during participant observations that most of the agricultural activities in the observed villages were carried out along Ngono River Basin. It was strongly argued by respondents that, uncontrolled human activities along Ngono River Basin as contributing to recurrent floods, experienced by people living further down the valley. Two participants of the focus group discussion had the following to say about increased environmental degradation in the community:

> …….there is uncontrolled human activity within 60 meters from the Ngono River basins. Most of the local communities practice their farming activities in this basin. However, we have observed in recent years most of the youth increasingly involved in brick making activities and stone quarrying along the river banks. This contributes further to the degradation of the river banks, which results in floods every season[52].

> ….. increased farming activity around different natural springs (*enchuro*) in this village has threatened the availability of clean and safe water especially during long dry spells. 30 years ago in this village, we had an *enchuro* that had clean and safe water throughout the year….we didn't suffer from water shortages during dry spells. But nowadays people have invaded these *enchuro* to undertake different farming activities. This has created scarcity of water, something we have never experienced before[53].

[50] Focus group discussion on with farmers 13th November 2013 at Mbale village (Own translation)
[51] Interview conducted on 17th September 2013 at Magata Village (Own translation)
[52] Interview conducted on 10th October 2013 at Bugorora village (Own translation)
[53] Interview conducted on 29th October 2013 at Kabingo village (Own translation)

State policy and the laxity of government officials in enforcing environmental laws were also cited as the causes of climate change risks in the community. Some of the local communities complained about the state policy following the government measure that requires farmers to use fertilizer when farming. It was reported that addition of fertilizer in the soil affects seriously the productivity of the soil since the fertilizers contain nitrous oxide. The addition of fertilizer in the soil also contributes to the emissions of nitrous oxide in the atmosphere which increases the atmospheric greenhouse gas concentration. One of the farmers in the focus group discussion in Mbale village was very explicit that the additional fertilizers contributed to climate change risks. In addition, he also put it clear that for the local communities, particularly those who use fertilizer in their farming activities the fertility of the soil was decreasing from time to time.

Regarding the laxity of government officials in enforcing environmental laws, it was revealed that severe land degradation resulted from ignorance among the local communities due to the lack of environmental education that should have been provided by environmental officers and village authorities. Some of the participants of this study had no concept of why the environment would need to be conserved. One of the participants in the focus group discussion explained that:

> ….government officers should be responsible for what is happening because we have been told that, there are environmental and natural resources officers, but all of them are doing nothing. If those officials were doing their job effectively, the problems of climate change we currently face, would not be the way they are today[54].

These views, especially on the failures of government officials to enforce environmental regulations were supported by one programme officer of MAPEC, a local NGO dealing with agricultural and environmental projects in Missenyi District, he said:

> I think government environmental officers should be held responsible for environmental degradation. There are environmental regulations and by-laws, but still people degrade the environment. In my view, I think the government hasn't done enough to enforce these regulations, and create awareness regarding the relevance of conserving their environment. This is the reason for increased environmental degradation that contributes to climate change risks[55].

Air pollution was also perceived to be a major cause of climate change. Respondents listed a number of sources of air pollution, including: the burning of fossil fuels from industries and

[54] Focus group discussion with farmers on 10th November 2013 at Mbale village (Own translation)
[55] Interview with programme Officer on 2nd October 2014 at MAPEC office Kyaka (Own translation)

vehicles; firewood (a major source of energy for cooking in the study area); as well as the burning of car tires and plastic materials. The following remark about air pollution was given by a female participant in Kabingo village:

> …….I heard from the radio that increased carbon gases in the atmosphere as a result of industrial activities and traffic movements have contributed to the concentration of greenhouse gases which contributes to climate change. Nowadays, there are many vehicles and motors cycles in this village, in the past there was only one car, which belonged to a catholic priest. Nowadays, we have many motor cycles and vehicles which contribute to air pollution. However, burning of bushes also adds carbon gases to the atmosphere[56].

It was reported by the participants that within the community itself, there is a concentration of smoke in the atmosphere due to burning of rubbish within the community. According to the Village Chairman of Magata, the practice of burning of rubbish was contributing to air pollution and leading to a warming effect in the village. However, some of the participants pointed modernization as one of the causes of climate change risks. It was strongly argued during the focus group discussions that the communities were following the contemporary world and most of the things within the community were changing. It was reported that people were building modern houses and abandoning traditional houses. The construction of modern houses and roads used more environmental resources such as stones, timber, tree poles, sand and water. This increased use of resources escalates environmental degradation, which in turn contributes to climate change. Some participants believed that, although the community was making good progress in terms of development, it was posing more risks to the environment. From the focus group discussion in Mbale village, one participant had this remark concerning this pace of modernization:

> The speed of development in rural areas has contributed to environmental degradation, and ultimately to climate change. Currently, house construction in rural areas largely depends on timber, mud bricks and stones. The extractions of these resources can cause a lot of damage to the forests and the environment at large. In the past traditional Haya houses were made up by a single thatched-roof round built with a single entrance, but recently people have money and everyone is struggling to build a modern house, which contributes to environmental degradation[57].

[56] Focus group discussion with farmers on 26th October 2013 in Kabingo village (Own translation)
[57] Focus group discussion with farmers on 13th November 2013 at Mbale village (Own translation)

***Supernatural causes of climate change risks***

There were many local communities who perceived climate change as a supernatural phenomenon. The majority of the participants during focus group discussions in all six villages attributed climate change risks to an expression of God's anger with human beings. They attributed any disaster or changes on their local climate to the anger of God. It was strongly argued in the community there are many sinners and God was unhappy with such behaviour. Some believed that God was punishing the local communities because of their sins. According to the participants, in the past it was unusual for an unmarried girl to become pregnant before marriage and, if such an incident occurred in the family, it would have been impossible for that girl to live with her parents in the same house. But it has become more common for girls to become pregnant and give birth in their parent's residence or abort their pregnancy while living with their parents. Thus, it is believed that the climate change risks are the curse of God due to the increase of this behavior in the community. Local communities relate this punishment to the punishment cited in the Holy Bible when thousands of years ago, God decided to punish human beings for their misbehaviour. God brought storms, whereby many people died and property was destroyed. One respondent explained this sentiment in the following quote:

> It seems we are not conforming to what God needs us to do. We have entirely ceased to fear God. We don't respect the almighty God any longer; this has resulted in many people ceasing to attend Sunday services in church or Friday service in the mosque. This has caused the community to detach itself from God. This creates a fearless community and as a result many people misbehave and they do not live through following the Ten Commandments of God…. God is unhappy with this behaviour and he punishes us by withholding sufficient rains. We have to keep praying in churches and mosques to seek his deliverance[58].

Additionally, many participants expressed the view that a lack of respect towards traditional customs had caused the anger of ancestral spirits, which ultimately has resulted in climate change risks. The main reason for the perceived anger was due to the failure of local communities to appease ancestral spirits and the Gods of rain through the execution of traditional rituals. Some of the participants in the focus group discussions and interviews had the opinions that, certain evil deeds can cause the wrath of ancestral spirits to continue over generations. They argued that, persisting anger of the ancestral spirits has affected the patterns of weather and climate. Other participants believed that the abolition of the traditional ruler (*Obukama*) contributed to the worsening of community behaviour. It was

[58] Interview conducted on 23rd September 2014 at Magata village (own translation)

reported by the participants, that the traditional ruler had an important role in preserving behaviour and ensuring that the ancestral spirits were properly worshipped within the community. However, the present generation does not seem to hold these values in high regard, thus angering the spirits. Some others believed that the failure of the local communities to offer sacrifices to ancestral spirits and traditional Gods (*wamara*) of the sky before planting can anger them, leading to a scarcity of rains. One elderly respondent from Mbale had the following view regarding the failure to offer sacrifices to *wamara*:

> I think the lack of practicing traditional customs within the community has provoked ancestral spirits and the traditional God. We don't respect our traditional Gods anymore, and due to this, God cannot intervene in case of drought or rain scarcity. In the past if there was a shortage of rains in the community; people could take sacrifices to the traditional Gods and it would rain. But nowadays, all these traditional practices are not performed within the community and this is the reason for having a scarcity of rains. The establishment of western religion is behind this failure to give sacrifices to *wamara* as western religions perceive that traditional customs are against God's will. Currently, the community does not believe in traditional customs anymore[59].

Most of what the elder said was reiterated and stressed by the traditional spirit medium or traditional spiritual healer (*embandwa*) in Missenyi District that, the present life within the community has driven away all lesser Gods. He strongly argued that the community has been overwhelmed by Christianity, and as a result all traditional practices connected to giving sacrifices to *wamara* have been abandoned. He stated that since then, local communities live without consulting *wamara,* and live in adultery. He insisted that the breaking of traditional practices within the community is an affront to *wamara*. The consequence of these circumstances is that, *wamara* cannot intervene on behalf of the community and this has created serious changes in the climate and weather patterns.

### 6.3 Perceived negative impacts of climate change

This section unveils the way climate change risks interact with other changes to create vulnerable communities in the study area. Particularly, the section presents the perceived socio-economic and environmental implications of the changes of local climate from the intersection these risks. This will foster an understanding of different adaptation practices employed by the local communities in adapting to vulnerability and climate change impacts in the study area.

[59] Interview conducted on 13th November 2013 at Mbale village (Own translation)

### 6.3.1 The questionnaire

The findings from the questionnaire surveys show that local communities have been experiencing negative consequences, socially, economically and environmentally due to the perceived changes of the climate and other different on-going changes. These changes experienced by the local communities in the study area have driven the community to change their farming practices and other livelihood activities. Different on-going changes (see chapter 5) in the study area undermine the adaptive capacity of the communities to climate change risks. The general picture of respondents' opinions on the negative consequences of climate change is demonstrated in Figure 22.

Figure 22 shows that crops and livestock health, household income, overall human health, food availability, water availability, and status of the environment were all reported by the respondents to have been negatively affected by the climate change and other on-going changes in the area. It was revealed that, the magnitude of these implications differs from one village to another and from one household to another due to the different adaptive capacities and socio-economic base among the local communities. The analysis indicated that, about 89.7% of all the respondents were of the opinion that these changes triggered incidences of pests and diseases in crops and livestock. 89.3% felt that such changes have caused the decline of annual income for both households and communities at large. About 86.6% of the respondents experienced more threats to their health due to these changes. 87.3% reported that these changes have damaged the natural ecology surrounding the village. Moreover, 83.8% of all respondents reported to have experienced food insecurity. Additionally, water shortages were reported by 77% of the respondents to have been caused by these changes. More than half (58%) of the respondents were of the opinion that these changes were causing rural-urban migration especially the youths, who were moving to urban areas to seek work.

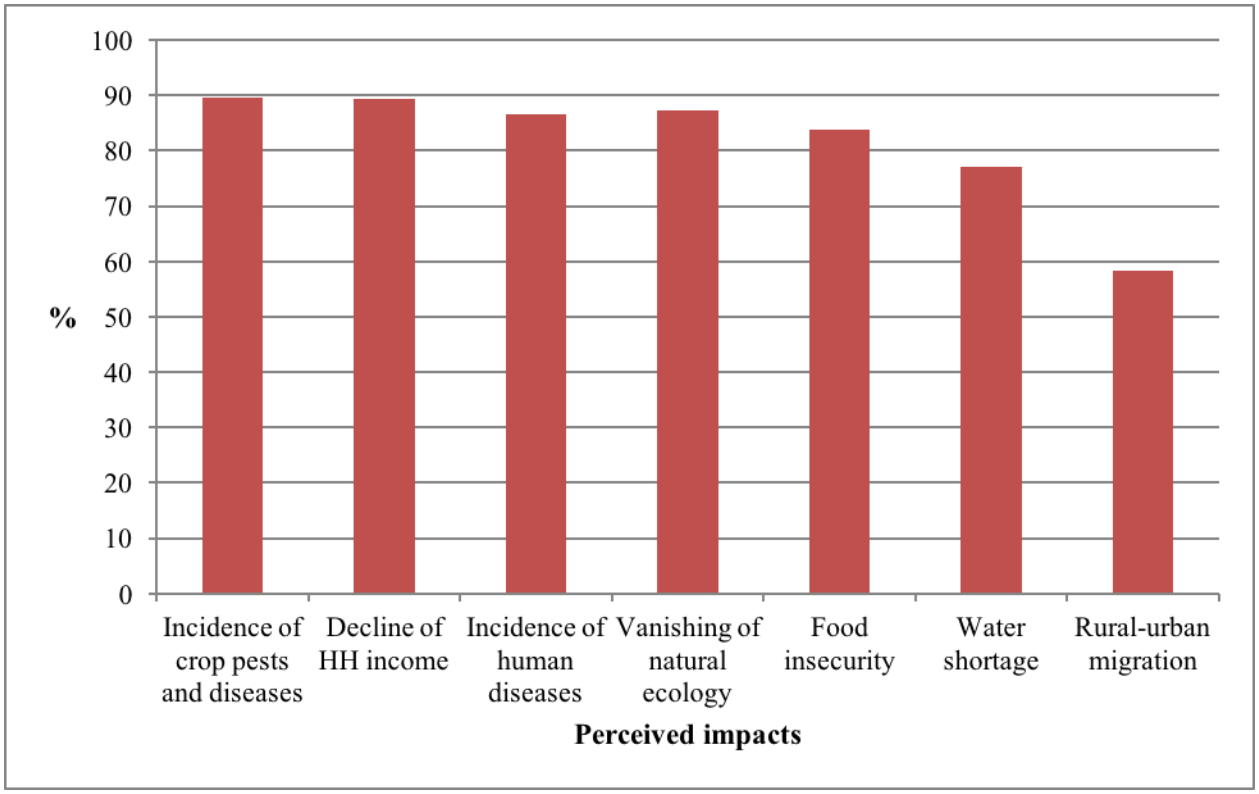


**Figure 22: Socio-economic and environmental implication of climate change**

***Source*: *Fieldwork (2014)***

(*Multiple responses were possible*)

Figure 23 presents the opinions of the respondents regarding the impacts of climate change at the village level. There were no large differences when compared to the overall perceived impacts of climate change (Figure 22). It was reported by the respondents that incidences of pests and diseases in crops and livestock were increasing in recent years due to climate change. The percentages of respondents that agreed with this claim included 98% of the respondents from Magata, 92.9% from Katanga, 93.8% from Karutanga, 81.1% from Bugorora, 83.3% from Kabingo and 88.4% from Mbale. On average annual income, 89.3% of the respondents from six villages admitted that climate change has caused a decrease in average annual income in the area. Similarly, 89.8% of the respondents from Magata, 92.9% from Katanga, 85.4% from Karutanga, 88.7% from Bugorora, 85.7% from Kabingo and 93% from Mbale were of the opinion that climate change has reduced the income generated by both household and communities from farming activities. Apart from the reduced annual average income, the majority of the respondents from all villages, 96% for Magata, 80.4% for

Katanga, 79.2% for Karutanga, 81.1% for Bugorora, 92.9% for Kabingo and 93% for Mbale), perceived that climate change was threatening human health. Additionally, the majority of the respondents were concerned with the issue of vanishing of natural ecology surrounding the villages. The percentages regarding this claim were as follows; 96% from Magata, 73.2% from Katanga, 89.6% from Karutanga, 85% from Bugorora, 95.2% from Kabingo and 88.4% from Mbale.

Food insecurity within the studied villages was frequently mentioned by the respondents to have been caused by changes of the climate, about 93.9% of the respondents from Magata, 91.1% from Katanga, 52.1% from Karutanga, 100% from Bugorora, 76.2% from Kabingo and 86% from Mbale had the opinion that climate change has affected food production leading to food insecurity. Apart from food insecurity, local communities were concerned with the state of water availability. About 85.7% of the respondents from Magata, 62.5 % from Katanga, 75% from Karutanga, 75.5% from Bugorora, 76.2% from Kabingo and 90.7% from Mbale were of the view that water shortages had been caused by climate change. It was further reported that climate change has resulted in rural-urban migration especially for youths who left only elders in villages. This was reported by 53.1 % of the respondents from Magata, 58.9% from Katanga, 58.3% from Karutanga, 66% from Bugorora, 31% from Kabingo and 81.4% from Mbale.

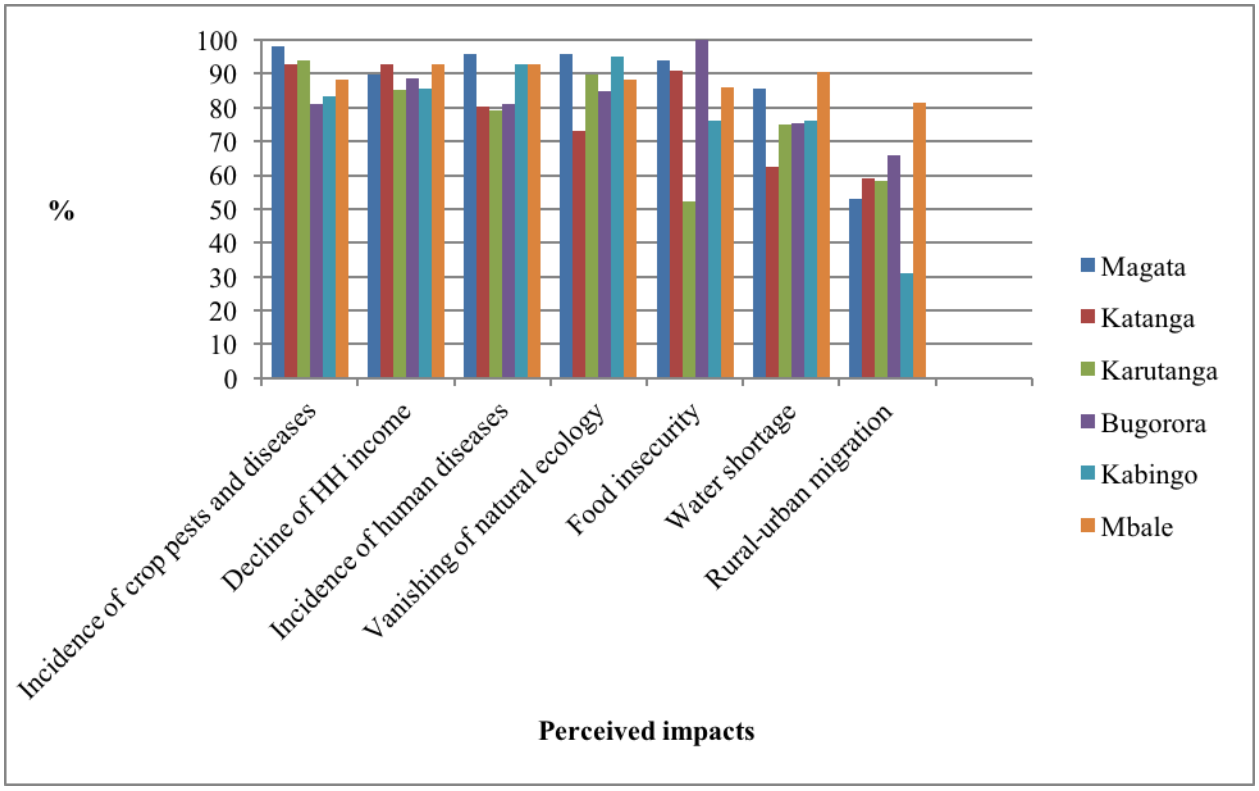


**Figure 23: Socio-economic and environmental impacts of climate change at village level**

***Source*: *Fieldwork (2014)***

(*Multiple responses were possible*)

### 6.3.2 Focus group discussions and interview narratives

The data collected by questionnaire surveys was similar to the data collected from interviews with local community members, research scientists, and experts. The impacts of climate change that were most frequently mentioned by the participants during focus group discussions and interviews, included: increasing incidences of pests and diseases for both crops and livestock, the decline of household income, and increasing the incidences of human diseases. Other impacts mentioned were: the vanishing of natural ecology, increasing incidences of food insecurity, water shortages, and rural-urban migration.

***Incidences of pests and diseases***

It was reported during the interviews and focus group discussions that increased pests and diseases in the area were due to climate change. The incidences of pests and diseases have contributed to the decrease in crop and livestock production in the study area. The magnitude

of these incidences was sharply felt during long dry spells. Different crop diseases were reported including severe cassava mosaic (*batobato kali)* and cassava brown streak disease (*michilizi kahawia)*. However, sweet potatoes were affected by sweet potato mosaic disease, and for the maize crop the primary diseases were leaf rust and maize streak. As it has been discussed in the previous chapter (chapter 5), the Haya depend on banana production as their main staple food. Apart from being seriously affected by BXW disease, banana crops were also affected by black sigatoka, locally called *panama*. Local community members reported that these diseases have been affecting the production of banana for decades due to changes in climate. Coffee also has been affected by various diseases. The most cited diseases during the interviews included leaf rusts and coffee fusarium wilt diseases. These diseases have reduced the production of coffee in Kagera region to a great extent. The results also show that livestock keeping is seriously affected by diseases, with foot and mouth disease, rift valley fever and East Coast Fever being the most commonly mentioned. In regards to the pests affecting the production crops and livestock in the study area, nematodes locally called *obuuka* and beetles were reported to be a major problem in bean production. Likewise, pests like beetles locally known as *ebitanda* and banana weevils locally called *ekiuka* were known to attack the banana fruits in the *kibanja*. In maize production, it was reported that the most stubborn pests were tailed caterpillars and maize stock borers locally called *kiuka*. The account by the DAO of Missenyi District explains what people experience:

> In recent years the incidences of new diseases and pests have been a problem for crops and livestock production. Once we try to find the cure for a certain disease, another new disease emerges. Most of the pests and diseases are favoured by climate conditions, especially long dry spells. In Muleba district it was possible to go more than 20 years without observing new diseases for crops and livestock, but in recent years we have been observing new diseases after short times. I think climate changes motivate recurrent incidences of new pests and diseases. For example, nowadays we have a disease known as *batobato* kali (severe cassava mosaic) affecting cassava, and in the past we had *East Africa batobato* (cassava mosaic) which was not affecting much cassava. Due to climate changes in recent years we have observed cassava mosaic viruses uniting with other viruses from Uganda forming severe cassava mosaic. Severe cassava mosaic has affected much of the production of cassava. While researchers are striving to get species resistant to this disease, another new disease called cassava brown streak has emerged and it is more dangerous than severe cassava mosaic. Therefore, it is obvious that when the researchers get the solution of one disease, another disease arises as the result of climate change[60].

[60] Interview with DAO on 10th October 2013 at Missenyi District Council (Own translation)

***Decline of annual average income***

The Haya people in the Ngono River Basin generally rely on crop production and livestock keeping activities as their main sources of income. The data shows that these activities have been affected by the impacts of climate change leading to decline of household income. Those impacts are not only felt at household level but also to the entire community. The magnitude of those impacts differs from one household to the other and from one village to the other. Such variation depends on different factors such as planting dates, the types of crops cultivated, and geographical location. It was reported by the participants during focus group discussions and interviews that climate change has contributed to poor agricultural and livestock production leading to the decline of household income. This showed that climate change among other changes had affected annual average income at the household and community level. One of the interviewees in Kabingo village explained the real situation in the community as such:

> The production in our farming and livestock keeping activities has decreased in the last three decades. We are trying to work hard and to cultivate all our plots but the production is not impressive. The decrease in productivity has negatively affected our income. We are becoming poorer than in previous decades. Farm earnings have decreased because of climate change. The rain is decreasing and the seasons have changed unlike in previous decades. What we are planting now, we are not sure if it will be able to be harvested. In the past, the harvesting of temporary crops was mostly done in December and the rains were enough, but in recent years things have changed. This has affected the income of the households and the community at large[61].

According to village authorities in six selected villages, the decrease of household incomes was affecting different village development plans. The village governments do not receive sufficient subsidies from the local government so they depend on contributions made by the local communities to execute different developmental projects. Similar sentiments were echoed by the Chairman of Kabingo village as evident from the following passages:

> In the past we had no problem with rains because it was enough and the production was good. Nowadays, the rains are not enough and sometimes unpredictable. This has affected the farm earnings and reduced the income of the households and the community. This is well justified by looking at different contributions which the community members have to made for different

[61] Interview conducted on 7th October 2013 at Kabingo village ( Own translation)

> developmental projects such as school construction. It is difficult to raise the required amount from the community due to the decrease of farm earnings[62].

The findings show that it was difficult for most of the local communities to contribute to developmental projects because they did not even have enough money to cover basic needs such as school fees for their children and medical services. The following excerpt from a focus group discussion participant illustrates this sentiment:

> I don't know what will happen if my son will pass his primary school examination, because I don't have any source of income. In the past it was possible for me to pay for school fees for my children because the harvest was good. Currently, the harvests from coffee and other crops are not good, hence it is difficult to meet the school fees[63].

***Increased human diseases***

It was reported by the local community members as well as experts, that climate change was posing a threat to human health. The most frequently mentioned disease by the participants was malaria, and it was reported that the prevalence of malaria in recent years was high compared to previous years. Malaria was more prevalent in Magata, Karutanga, Katanga and Mbale because of their location in the highlands. The main reason for the increase in malaria was the increase of mosquitoes in the area. In the past, mosquitoes could not thrive in the area due to the colder weather. Because of the increase in temperature, the climate has become warmer, creating conditions favourable for mosquitoes. Other diseases such as diarrhoea and typhoid were spreading due to insufficient access to clean and safe water in the area. Malnutrition was reported to affect many children due to a lack of sufficient food. The decrease in food crop productivity brought on by long dry spells and rain shortages has played a large role in these food shortages and hence contributed to malnutrition. This has particularly affected the health of vulnerable people, such as those living with HIV/AIDS, pregnant women, children and the old people. This situation was reflected by a focus group discussion participant in the following quote:

> I have observed more health threats within the community due to climate change. Health threats are caused by a lack of nutrients because of eating foods which lack essential nutrients. In the past we had traditional foods which had enough nutrients, but due to these changes those foods have disappeared hence our bodies have become weak, and once we are attacked by diseases we are easily affected[64].

[62] Interview with Kabingo Village Chairman on 10th October 2014 at Kabingo village (Own translation)
[63] Focus group discussion with local communities on 8th October 2013 at Bugorora village (Own translation)
[64] Focus group discussion with local communities on 8th October 2013 at Bugorora village (Own translation)

The general understanding from the participants of this study shows that climate change has caused a decrease in nutritious food within the community which has contributed to a rise in disease among community members.

***Vanishing of natural ecology***

It was reported that in the past 30 years there were dense forests and grasses within the communities. The natural ecology surrounding the communities provided the communities with access to firewood as well as grasses for mulching their banana farms. In recent years the natural ecology of the area has disappeared due to climate change and other on-going changes. The scarcity of firewood was reported in every interview with local community members and other stakeholders. Firewood is becoming expensive, one bunch of firewood stood at 2,000 Tshs when this study was carried out. However, the evidence showed that the persisting failure of farming activities due to climate change has attracted people to pursue other livelihoods, which can threaten the natural ecology. For instance, most of the youths are involved in brick making activities, which consume a great deal of firewood in the study area. Others have been reported to engage in charcoal making activities in the study area, which puts more pressure on forest resources as it requires a great deal of firewood. It is possible that in the near future, local communities will suffer from firewood shortages due to sustained deforestation and forest degradation. One interviewee reflected on the situation as such:

> The only source of energy in this community is firewood, which has been decreasing in recent years. In the past firewood was not a problem in this community. There were dense forests with indigenous trees, in which children could easily go and collect firewood. In the last decades, this has become a big problem; firewood is not easily accessed within the community. Children have been spending most of their evening time after school hours searching for firewood. Sometimes they have to walk for long distances to neighbouring villages to collect firewood[65].

Long dry spells have affected the availability of traditional grasses locally called *omushanje* used for mulching the *kibanja*. Another type of grass locally called *ekinshwi*, which is traditionally used for carpeting earthen floors in traditional houses have also become scarce within the community. The findings showed that in recent years both varieties of grasses have been decreasing to the extent of extinction. The decrease of *omushaje* has greatly affected the production of the *kibanja* because mulching is not sufficiently done. It was reported by the participants during focus group discussions that nowadays people must either spend a great

[65] Interview conducted on 20th September 2013 at Magata village (Own translation)

deal of money or walk long distances to find *omushanje* and *ekinshwi*. The price of one bunch of *omushanje* and *ekinshwi* was 1,000 Tshs each when this study was conducted. This price was expensive for local communities because mulching the *kibanja* takes a lot bunches. However, it was also reported that during long dry spells there are severe shortages of pastures, this in turn makes it difficult for livestock keepers to graze their herd. Even though in some villages like Mbale and Karutanga, where they practice communal grazing, it is still difficult for them to secure good pastures due to the prolonged dry spells in the study area. The grazing of livestock is made even more difficult because large parts of village land, that had been used for grazing has been given to private investors under the canopy of *Kilimo Kwanza* initiatives (cf. 5.1.4).

***Food insecurity***

Food insecurity was reported as a serious issue especially for villages located in Muleba District including Magata, Katanga and Karutanga. Community members, local leaders and district authorities argued that climate change had triggered decreased rains and a rise in crop pests and diseases, which has reduced food production. Community members reflected the situation as such:

> As you can see the entire bananas in this *kibanja* have been affected by BXW and banana weevil diseases. It is difficult to yield sufficient food to feed the family throughout the year. In the past we used to harvest food throughout the year in this *kibanja*. Nowadays, the same *kibanja* cannot produce food which can sustain a family even for one month. With this situation, we face food insecurity frequently. Our indigenous bananas have disappeared due to decreased rains[66].

It was observed during the transect walks in Magata, Katanga and Karutanga, that most of the *bibanja* were seriously affected by both pests and diseases or long dry spells. Some of the households in these villages that were facing food insecurity required food aid from the government and NGOs. This was justified by the DAO of Muleba District as presented in the following quote:

> In this district, the local communities depend on banana as their staple food. In recent years, the production of this crop has decreased, leading to food insecurity. Most of the households have lost up to 80 % of their banana farms due to BXW disease. This is a serious problem to these families because their main source of food comes from the *kibanja*. We have been advising them on different measures to address the problem, but this can only be successful in short run. I think they need food aid in the short run while working on the problem in the long run[67].

[66] Interview conducted on 22nd September at Magata village (Own translation)
[67] Interview with DAO on 10th September 2013 at Muleba District Council (Own translation)

The unreliable rains made the community feel more unsafe as it is difficult for them to undertake irrigation farming due to their low income, lack of technology as well as the lack of institutional capacity to adapt to drought. It is from this basis that they have now decided to cultivate crops which can be sustained in drought conditions, such as upland rice, cassava and sweet potatoes. Hoffmann (2011) explained that food insecurity among the rural urban poor in Africa is exacerbated by climate change as it affects the potential natural resource base on which agricultural sector depends. Along with climate change, population growth together with the decrease in the productivity of the *kibanja* is contributors to food insecurity. It was reported that the population has increased, leading to land fragmentation. Whereas in the past most of the *bibanja* were large, ranging from 3 ha to 10 ha, it is now difficult to find any *kibanja* with more than 3 ha in the study area due to population increases (cf. 5.4). Local communities are left with small pieces of *bibanja* that cannot satisfy household food requirements as they have been subdivided to family members.

***Increased water scarcity***

Many of the participants expressed concern about water shortages in the study area. It was revealed that water availability had been compromised by climate change particularly through increased and repeated long dry spells. Climate change in the area had limited the availability of rains, which reduced surface runoff and flow of the Ngono River Basin as well as other important streams which currently cannot flow year-round. Some of the natural springs locally called *enchuro* in the area were reported to have dried entirely. The drying of *enchuro* has compelled many local communities to depend entirely on private water wells thus, leading to increased water borne diseases, which, in turn, threaten human health. It was revealed during participant observation that, water shortage is a serious problem in Bugorora and Kabingo village. The following quote from the Kabingo village Chairman confirms this claim:

> In this village there were more than eleven e*nchuro,* which provided clean and safe water throughout the year. But currently we have only three enchuro within the village, and one of them almost dries out in this summer. This is a big challenge to the community as we have to depend on only two sources of water which are not enough for the whole community. Sometimes we have to walk long distances to fetch water, and this affects other livelihood activities since we spend most of our time searching water[68].

[68] Interview with Kabingo Village Chairman on 12th October 2013 at Kabingo village (Own translation)

Decreasing water sources as mentioned in the above quote has compelled the community to depend on water wells excavated in the wetlands. Water from wells is not treated, and is thus not safe as it contributes to water borne diseases like diarrhoea and typhoid. On this aspect, one participant had the following remarks:

> During the dry season like this time, access to water is becoming a serious problem. Our traditional natural springs are drying. We have excavated water wells nearby the wetland. This water is not clean and safe. We are suffering from typhoid because of drinking such water. But we don't have any alternative we have to continue using the same water[69].

**Figure 24: Different sources of water in Magata and Kabingo Villages**

***Source*: *Fieldwork (2014)***

***Increase of rural-urban migration***

One noticeable aspect in the current rural communities is the rate at which people in rural areas migrate to the urban centres. In recent years there has been an increasing trend in rural-urban migration in developing countries particularly youths who move into the urban areas from the rural areas seeking better opportunities. This situation has contributed to the increase of population in urban areas, while the population in the rural areas is decreasing with elderly people, women and children often remaining behind. Many people in the rural areas give up on agriculture as a result of the reduced precipitation and long dry spells caused by climate change. The change of weather patterns destroys large amounts of agricultural produce and disrupts livelihoods activities. Most youths who migrate from rural areas to urban areas hope

[69] Interview conducted on 30th September 2014 at Karutanga village (Own translation)

to find a job and send money back home to help their families. Most of the elderly population usually bears the responsibility to take care the children, which in turn, has become a burden on the elderly (see Ndaki, 2014).

It was reported by the participants in the focus group discussions in Magata and Katanga Villages that, rural-urban migration has become very common among youths especially with the frequent agricultural failures. This failure has caused many boys and girls to migrate from their villages to urban areas after they had found it difficult to survive in their villages. Most youths in the study area have moved to urban towns and cities including Buseresere, Kahama, Bukoba, Mwanza and Dar es Salaam. With the able-bodied citizens gone, the remaining population in rural areas cannot produce enough food. However, some parents have stated that they have been receiving financial aid (remittance) from their children in the cities, which have helped their upkeep. Others report that apart from receiving remittances, they receive clothes, food and other essential items. In some of the households, remittances have improved their lives as people can build modern houses and connect their houses to the electricity grid. However, not all parents were happy about these developments, and some condemned their children for leaving. They said that their children were not helping them to settle various financial problems irrespective of living in town. It is important to point out that, it is not always possible for youths who move to urban areas to get a job, because the job markets in most of urban town and cities in Tanzania is becoming a big challenge. Thus, many youths are unemployed which makes them unable to help their parents.

**Figure 25: A modern house constructed in Bugorora Village**

***Source*:** *Fieldwork (2014)*

### 6.4 Interim conclusion

This chapter has aimed to elucidate the way local communities make sense and put meaning on what they observe associated to changes in the state of the local climate. The findings have shown that some of the local communities have a great sense of awareness about climate variability and change current happening in the study area. This is because local communities depend highly on environmental resources for farming and livestock production. However, the majority of the local communities perceived changes in the rainy season more than other seasons. They were able to perceive a shortening of the rainy season along with its increased variability, distribution and intensity. A significant number of the respondents also attributed climate change risks to supernatural forces. The findings also revealed that climate change risks interact with different on-going changes to produce impacts, which contribute to their vulnerability. Thus, this chapter has successful presented various socio-economic and environmental implications of climate change on the local community's livelihoods in the study areas.

# Chapter Seven

## Everyday Practices to Deal with Climate Related Risks

> Recurrent shifting of rain patterns, prolonged drought seasons and incidences of pests and diseases in both crops and livestock are not a new phenomenon in this village. Most times we have been responding to these incidences using different practices based on our socio-cultural context…. though lately it seems those practices are impotent in adapting to these extreme weather related events[70].

Different on-going changes and extreme climate change risks discussed in previous chapters have undermined many indigenous adaptation practices. Although some of these changes were beneficial to local communities, the data shows that they have also contributed to their vulnerability. Consequently, the community's livelihood systems are increasingly affected by climate change, which creates food insecurity and poverty. The focus of this chapter is to provide an understanding of the everyday adaptation practices used by the Haya to adapt to climate change. It should be noted that the Haya do not only depend on their indigenous knowledge to adapt to climate change, but sometimes they use outside knowledge provided that the knowledge system conforms their socio-cultural context (c.f. 2.4). This chapter starts by examining the different sources of knowledge that inform climate change adaptation practices of the Haya. The development of the indigenous knowledge in the local context is presented to show how this knowledge is synthesized, shared and passed onto future generations. Finally, different adaptation strategies will be discussed to demonstrate the routinized aspects of the everyday practices that have been used by the Haya to withstand climate change risks for many years.

### 7.1 Sources of knowledge regarding climate change adaptation

The respondents were asked to mention different sources of knowledge for climate change adaptation practices and how this knowledge was shared and disseminated within the communities. Figure 26 indicates that the primary sources of knowledge for climate change adaptation were predominantly local. Most of the knowledge obtained through informal sources is labelled as indigenous knowledge, because it is embedded in socio-cultural contexts of the Haya. The sources of the knowledge included: personal experience (67%), parents or family (81.4%), friends or neighbours (73.9%) and social groups (64.9%). Other

[70] Focus group discussion with villagers on 8th November 2013 at Mbale Village (own translation)

major sources of local knowledge included church or mosque (32%), community gatherings (75%) and village leaders (44%). However, local community members also obtain knowledge on climate change adaptation from formal sources. The knowledge obtained through formal sources is called expert or western knowledge according to local community members, as it is not based on their socio-cultural context. These sources included: media (27.1%), extension staff members (63.2%) and NGOs (47.4%).

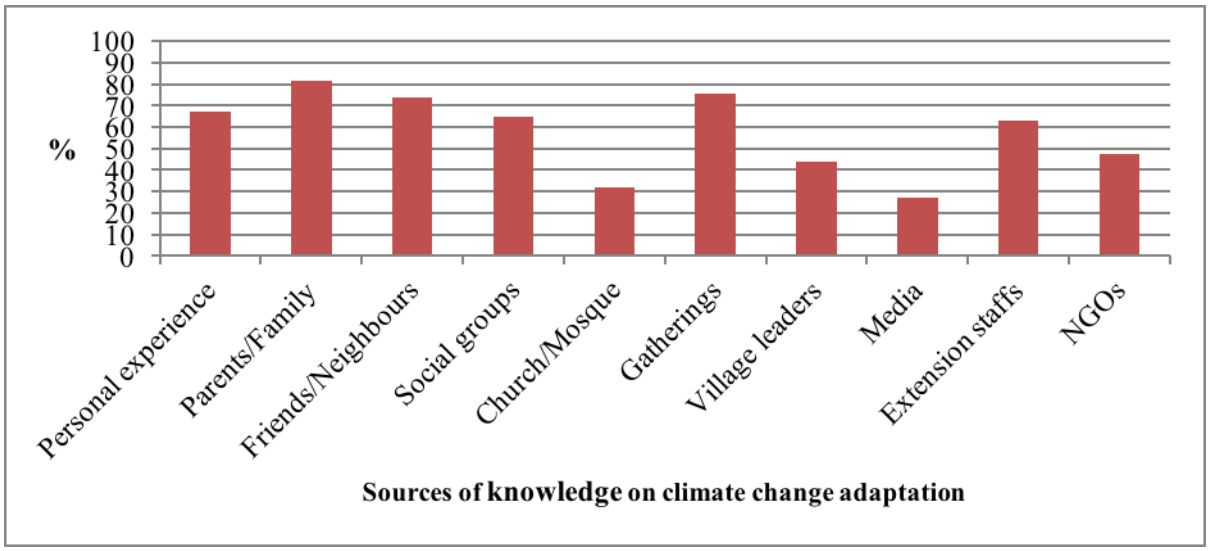


**Figure 26: Sources of knowledge concerning climate change adaptation**

***Source*: *Fieldwork (2014)***

(*Multiple responses were possible*)

Responses on local sources of knowledge regarding climate change adaptation varied when the data was broken down across the villages. Figure 27 shows that 73.5% of the respondents in Magata Village, 51.8% from Katanga, 70.8% from Karutanga, 75.5% from Bugorora, 66.7% from Kabingo and 65.1% from Mbale acquired knowledge on climate change adaptation from personal experience. The majority of the respondents from all villages, that is 95.9% for Magata, 75% for Katanga, 87.5% for Karutanga, 71.7% for Bugorora, 85.7% for Kabingo and 74.4% for Mbale acquired knowledge concerning climate change adaptation from either their parents or families. It was further reported by some respondents that the persisting climate change risks have caused them to learn what their neighbours were doing so that they too could adapt. The percentages of respondents that reported this source of information are as follows: 79.6% from Magata, 73.2% from Katanga, 87.5% from

Karutanga, 66% from Bugorora, 64.3% from Kabingo and 72.1% from Mbale. When it came to social groups, the majority of respondents from all villages, that is, 49% from Magata, 64.3% from Katanga, 50% from Karutanga, 88.7% from Bugorora, 73.8% from Kabingo, and 62.8% from Mbale reported it as a source of climate change adaptation knowledge.

Furthermore, churches or mosques were important sources of knowledge regarding for climate change adaptation in some villages i.e. 45.2 % of the respondents in Kabingo, 37.5 % for Katanga, 35.4% for Karutanga, 37.7% for Bugorora and 37.2% for Mbale. It is interesting to note that in Magata, no respondents mentioned churches or mosques as important sources of knowledge concerning climate change adaptation. Community gatherings for different activities and events were reported to be important place for learning adaptation practice to climate change. This source of knowledge was reported by majority of the respondents from all villages, 87.8% from Magata, 96.4% from Katanga, 67.8% from Karutanga, 43.4% from Bugorora, 69% from Kabingo and 86% from Mbale. Additionally, village leaders were playing an important role in disseminating knowledge on climate change adaptation. The percentages regarding this source were 40.8% of the respondents in Magata, 51.8% for Katanga, 62.5% for Karutanga, 22.6% for Bugorora, 28.6% for Kabingo and 58.1% for Mbale.

Formal sources of knowledge acquisition concerning climate change adaptation also varied across the villages. When it came to extension staff members 65.3% of respondents from Magata, 89.3% from Katanga, 56.3% from Karutanga, 60.4% from Bugorora, 71.4% from Kabingo and 30.2% from Mbale reported them as a source of information about climate change. About 34.7% of the respondents from Magata, 23.2% from Katanga, 16.7% from Karutanga, 9.4% from Bugorora, 47.6% from Kabingo and 37.2% from Mbale, declared that media such as radio, newspapers and television were important sources for climate change adaptation information. The local NGOs in the study area were reported to be important by the respondents as they were training the local communities on how to adapt to climate change risks. This source of knowledge regarding climate change adaptation was largely mentioned in Magata Village (90.6%), Kabingo Village (69%), Mbale Village (60.5%), and Katanga Village (37.5%) but not in Karutanga 10.4 % and Magata 18.4 %.

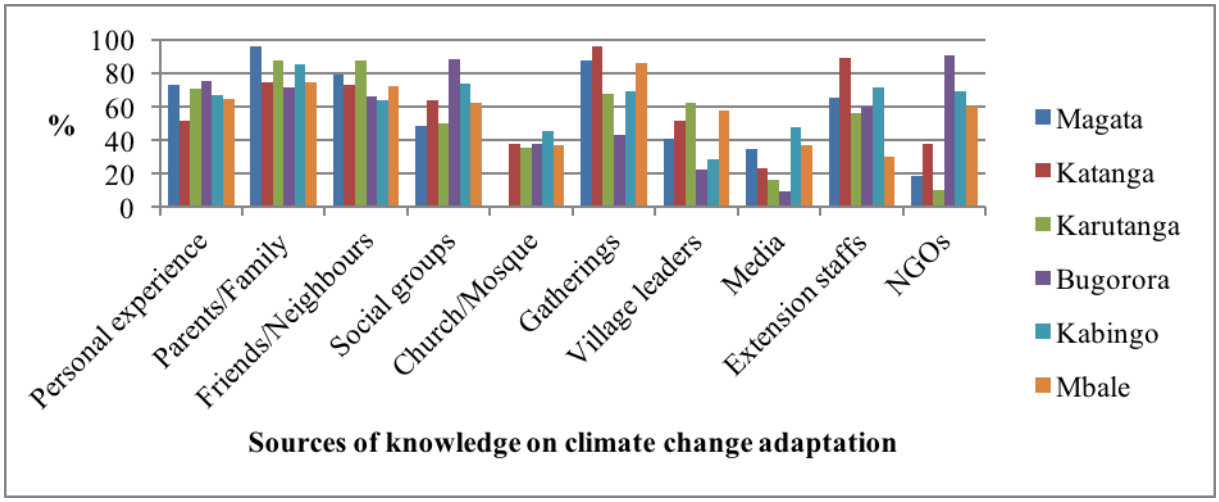


**Figure 27: Sources of knowledge regarding climate change adaptation at village level**

***Source*: *Fieldwork (2014)***

(*Multiple responses were possible*)

### 7.2 Development of indigenous knowledge at the local level

Indigenous knowledge evolves from within the community and is transferred from one generation to another. Although this knowledge is believed to have been developed by a community, this belief may be contested as much of what local communities claim to be 'indigenous knowledge' may have originated from outside due to various external influences (cf. 2.1). The findings revealed that indigenous knowledge has been developed, shared and transmitted from one generation to another. The learning process of indigenous knowledge is entrenched in the socio-cultural context of the Haya through social groups, churches or mosques, personal experiences, and community gatherings (cf. 2.3). This knowledge is easily shared and transmitted within the Haya communities because it exists within their belief systems and is informed by their moral values. The majority of the participants during the interviews and focus group discussions reported to have obtained such this knowledge from either their parents or families. This was one of the important sources of indigenous knowledge development within the community as most of the children were trained by their parents to apply indigenous knowledge in different activities when they were still young. Some participants of interviews stated that they were taught by their parents how to practice indigenous farming and how to identify different indigenous medicinal plants for curing different diseases in both livestock and human being. The following sentiments form the base of this argument:

> I learnt this knowledge from my parents…when I was a young girl, I used to work with my mother in the *kibanja* every weekend. My mother taught me how to apply traditional knowledge and practices to address different problems caused by environmental changes. She taught me how to plant maize and beans within the *kibanja* using indigenous practices. When I grew up, I started using the same approach to teach my children to apply these traditional practices, which are based on indigenous knowledge and beliefs.[71]

**Figure 28: Children learning how to plant maize and beans from their mother**

***Source*****:** *Fieldwork (2014)*

Community gatherings, particularly village meetings, weddings, and funeral ceremonies were repeatedly mentioned by the participants in all the villages as important sources of indigenous knowledge development within the community. It is apparent that persisting environmental changes, particularly climate change risks have resulted in sharp debates in communities on how to adapt. In the community gatherings, people would discuss the challenges caused by climate change and they would learn from each other. As one female participant in the focus group discussion aptly put it:

> …..usually when there are community gathering especially funeral and wedding ceremonies, the dominant discussion among the people relates to repeated environmental changes. People often discuss how to overcome the incidence of *mnyauko* disease and increased drought…..my participation in such discussions

[71] Interview conducted on 23rd September 2014 at Karutanga Village ( own translation)

> has been helpful, since I have been able to learn what other people do to adapt to these on-going changes.[72]

Availability of different social groups (*obumoi* in Haya local language) within the community was deemed relevant concerning the development of indigenous knowledge. Within the study villages there are various social groups formed by the local communities to assist each other in the face of any environmental uncertainties that may occur within the community. Through participating in different activities done by social groups, members of those social groups learn from each other and apply the indigenous knowledge to their daily livelihood activities. Most females in Bugorora Village acknowledged learning various indigenous farming practices from their social groups. Social groups are comprised of people with different ages, and thus, it was possible the younger generation learns from the older one when they work together. The following testimony concerning the development and sharing of indigenous knowledge within the social group was given by one participant during focus group discussion in Bugorora Village:

> In the past before I joined this social group of *abagamba kamoi*, it was difficult for me to have good harvests of different crops. When I joined the *abagamba kamoi* group, I learned from other members how to use different indigenous based practices, which have improved my yields.[73]

Further analysis of the individual interviews revealed that local communities would sometimes combined their own indigenous knowledge with different local or western knowledge sources to create hybrid knowledge with new effective agricultural and livestock keeping processes. Thus, it is clear that indigenous knowledge from local communities is not an independent knowledge, but is rather, a combination of various forms of knowledge originating internally or externally used in the interests of household/community production (cf. 2.1). The evidence from the data shows that increased crop failure due to soil infertility, incidences of crop pests and diseases have revealed the limits of indigenous knowledge in adapting to these changes. Accordingly, local communities in all selected villages for this study have acknowledged combining of their knowledge with other knowledge in order to respond to climate change, and ultimately increase crop and livestock production. This was considered by the local communities to be an important step in improving and strengthening their indigenous knowledge to withstand different on-going changes, particularly climate

[72] Focus group discussion with villagers on 8th November 2013 at Mbale Village (own translation)
[73] Focus group discussion with female participants on 3rd October 2014 at Bugorora Village (own translation)

change risks. The following quote forms the base of this argument as it was explained by one of the participants of a focus group discussion in Magata Village:

> "…...I tried to combine both traditional and scientific methods to cure the fever in my goats. Initially I gave my goats the bitter leaf (*omubilizi*) juice to control the high fever before using an injection. Later on, I found out that the injection was effective to control the fever compared to bitter leaf juice. In the past some of my goats died due to the use of bitter leaf juice only.[74]

The above quotation indicates that the majority of the local communities in the study area have been using their knowledge as a first aid before seeking advanced knowledge, generally western knowledge to respond to different climate change risks. Thus, indigenous knowledge is used on a short term basis, and in the long term, this knowledge is integrated with other knowledge to seek permanent solutions to the problem. It is difficult to find local communities in the study area relying only on their own knowledge, since the on-going changes have limited the capacity of indigenous knowledge to adapt to these changes. Thus, in many cases, indigenous knowledge cannot be used independently; it has to be backed with other forms of knowledge to increase its effectiveness.

It was further revealed that local communities were conducting different local experiments in order to seek remedies for their daily problems associated with environmental change. Most of the experiments carried out by the local communities were attempts to control pests and diseases caused by climate change, as well as to adapt to recurrent dry spells and reduced precipitations. This was confirmed by one of the participants in Katanga village:

> I sprayed the mixture of water and ashes on the farm of maize in order to control ants (*obusisi*) and other pests, which were affecting the maize growth. Despite spraying several times, it seems this practice was not effective in controlling the pests because after a certain period of time the pests came back.[75]

Through experiments in their daily livelihood activities, local community were able to test if their own ideas could work in their farming and livestock activities. This phenomenon was widely reported by the respondents in Magata, Kabingo and Mbale, in which trial and error enabled community members to select suitable land for planting their crops. This method had numerous successes, for example, farmers in Mbale were able to discover that sweet potatoes

[74] Focus group discussion on 23rd September 2014 at Magata Village (own translation)

[75] Interview conducted on 26th September 2014 at Katanga Village (own translation)

can grow in wetlands during the long dry spell period because of the availability of water after some trial and error. In addition, livestock keepers tested different practices in order to control livestock pests and diseases which seem successful. In a nutshell, indigenous knowledge held by the Haya entails a combination of different forms of knowledge, originating internally and externally, which is being constantly updated to fit into the existing socio-cultural and environmental setting (cf. 2.1). Therefore, the perception that indigenous knowledge is purely locally based knowledge produced by the local communities themselves is not accurate in the study area.

## 7.3 Indigenous knowledge-based adaptation practices of local communities

This section will explain the local adaptation practices that are used by the Haya in order to reduce the negative impacts caused by the climate change. Though many of these practices were developed internally by the local communities, some originated outside the Haya communities (cf. 2.1). The following sub-sections present different adaptation practices reported by the local communities and stakeholders who were consulted during this study.

### 7.3.1 Adaptation practices against drought and reduced precipitations

In the study area, local communities are using their own experience and information sharing within the community to adapt to drought conditions and reduced precipitation. It was reported by the participants during the interviews and focus group discussions that various practices have been used by the local communities in facing long drought conditions and decreased rains.

***Farming and grazing in wetlands***

Over time, local communities in the study area have begun practicing their farming and livestock keeping activities within the wetlands in case there is a scarcity of rains and or a long drought season. This study was conducted during the dry season, and the majority of the local communities were observed doing their farming activities in wetlands. Undertaking farming activities in wetlands was mostly observed in Mbale, Magata and Katanga village, in which wetlands were perceived by the local communities to have sufficient water throughout the drought season. Those villages were planting a number of crops in the wetland including sweet potatoes, cocoyam and vegetables. It was observed during transect walks in Mbale village that a large part of the wetland in this village was cultivated by the local communities. Most of the farmers in this village were concentrated in one of the wetland area called

*Amradi* undertaking farming activities. This wetland area has been farmed by the local communities over decades and it is considered by the local communities to have played a great role in climate change adaptation. The following statements, two from Mbale villagers and one from the chairman of Mbale village confirm the relevance of the *Amradi* wetland for climate change adaptation:

> For many years we have been undertaking farming activities in the *Amradi* wetland. When there is a long drought season like what happened in the last two years, it is difficult to undertake farming activities in *rweya* due to the scarcity of rain. Thus, this wetland has been helpful in responding to long drought season in this village.[76]
>
> In recent years it is difficult to cultivate sweet potatoes in *rweya* during this drought season. The only way to respond to this drought condition is to cultivate in wetland. Cultivating in a wetland is not an easy task…but we have been trying and the harvests are good.[77]
>
> In case of long drought conditions, we have been advising the villagers to extend their farming activities to the wetlands. Most of the villagers have been responding positively but others not. Those who dare to undertake their farming in wetlands have been getting better harvests than those who cultivate in *rweya*. The *Amradi* wetlands have been helpful to this village and there are more than 80 households undertaking their farming activities in this wetland.[78]

However, the persistence of the long drought season has caused the local communities in Missenyi District to start engaging in rice farming within the wetland. This is a new crop introduced among the Haya in recent years. According to the DAO of Missenyi, rice farming was not practiced by the Haya in the past because banana farming and root crops farming had good production. With the recurrent long drought season banana production has decreased hence the local communities have turned to rice farming. Rice farming in this district is mainly done within *Amradi* wetland. Similar observation was made by Kangalawe et al. (2011) in the Great Ruaha River whereby local communities in near the river basin were cultivating in wetlands to respond to drought. Wetland cultivation during drought seasons was also reported to be common in Morogoro (Mbingu and Kilombero area) in the Mpolo catchment. However, The practice of wetland cultivation was also common in the semi-arid areas of Tanzania particularly in Shinyanga Region (Lyimo and Kangalawe, 2010). On the other hand, livestock keepers had also begun to utilize the wetlands and were grazing and watering their animals in the wetlands during long drought seasons. In this period there were

[76] Interview conducted on the 27th October 2014 at Mbale Village (own translation)
[77] Interview conducted on the 27th October 2014 at Mbale Village (own translation)
[78] Interview with Mbale Village Chairman on the 26th October 2014 at Mbale Village (own translation)

shortages of rains, which created a scarcity of pastures. The scarcity of the pastures was very noticeable in some villages including Mbale, Karutanga, Magata and Kabingo. Large swaths of the grazing areas in those villages had been sold to investors who had planted pines trees, leaving very little for grazing activities. Therefore, because of the persisting long drought conditions, the only alternative they had was to extend their grazing activities into wetlands.

While undertaking farming and grazing activities in the wetlands seems helpful to local communities in adapting to long drought season, the practice is controversial as it contributes to wetland degradation and the sedimentation of water sources. Some of the local communities were much concerned with such form of farming as it contributes for environmental degradation. It was reported by one of the respondents in Mbale Village that undertaking wetland cultivation can have negative impacts on other ecosystems and wetland biodiversity due to the use of fertilizers and pesticides. The following quote form the base of his argument:

> Application of chemical fertilizers and pesticides to some crops cultivated in this wetland has negative impacts to the living organisms living in the Ngono River Basin. This probably might have contributed to the scarcity of fish resources in this river unlike in the past when this wetland was not largely encroached by human induced activities[79].

It should be noted that despite the relevance of wetland resources in climate change adaptation in the study area, this farming system should be carried out very carefully, since majority of farmers in their study area, did not even know that their wetland farming was contributing to wetland degradation which made them more likely to practice unsustainable farming in the wetlands.

[79] Interview conducted on 15th October 2014 at Mbale Village

**Figure 29: *Amradi* wetland farming at Mbale Village**

***Source*: *Fieldwork (2014)***

***Planting of drought tolerant and early maturing crops***

In order to adapt to the long drought seasons and reduced precipitation, the planting of indigenous drought resistant crops is considered to be an important practice by the local communities. The most common crops cultivated during this drought period in the study area were millet, yam, sweet potatoes, cassava and cocoyam. Some local communities are known to plant crops that mature earlier such as sorghums. Both practices were helpful to local communities in withstanding drought, because these crops are less affected by the long drought season. It was reported during interviews in all six villages that planting drought resistant and early maturing crops enhances food security during the drought season. The following quote from a villager in Magata reflects this sentiment:

> My son if you have not planted drought resistant crops such as cassava and cocoyam, it means you want your family to starve. We always plant these kinds of crops with the expectation that it will help us during the drought seasons as it is difficult to harvest banana in the *kibanja* during that time. We usually plant these

> crops at the edge of the *kibanja* and they are really helpful in improving food security during drought season.[80]

Similar practices have been reported in other places of Tanzania. Silas and Jacob (2012), in their study conducted on fishing communities in the Rufiji river basin, observed that local communities were growing drought resistant crops to cope with drought conditions. Similarly, these practices were observed in Mkomazi sub-catchment, where local communities were responding to drought by planting drought tolerant crops such as maize and paddy (Ndaki, 2014). Additionally, in the semi-arid Singida region, it has been reported that local communities have been adapting to drought conditions by planting drought resistant crops (Lema and Majule, 2009).

Some of the participants revealed that some of crop species being cultivated within the community were brought by extension officers and NGOs from outside. These crops included the *fhia* banana species, as well as early maturing maize seeds that were helpful in adapting to long drought season. It was revealed during the focus group discussion in Mbale Village that in recent years extension officers have been supplying maize seeds which can mature 75-90 days, faster than standard maize seeds. Despite the contribution these crops have in climate change adaptation, participants expressed their anxieties toward the *fhia* banana species as it consumes a great deal of water and might supress the growth of the indigenous banana within the *kibanja*.

***Mulching of kibanja***

Long drought seasons contribute to moisture stress in the *kibanja* which leads to crop failure. As a result, Local communities have developed indigenous practices to respond to this moisture stress. The findings revealed that to deal with moisture stress, the Haya have been undertaking frequent mulching of their *bibanja* for two reasons. Firstly, mulching enhances soil moisture within the *kibanja* during drought and secondly, supresses weeds germination within the *kibanja*. It was reported by participants in the interviews and focus group discussions in all villages that mulching the *kibanja* was very important because when it is appropriately done, production is good throughout the year irrespective of the prevailing drought conditions in between. Most of the local communities reported carrying out mulching routinely and don't wait for the drought season. This was aptly explained by one of the extension officer as follows:

[80] Interview conducted on the 18th August 2014 at Magata Village (own translation)

> Local communities do not wait for drought, if a farmer has planted indigenous banana and coffee, they always mulch their *bibanja* with grasses. This is the first thing to do in order to maintain the soil moisture. Usually farmers are aware that during long drought seasons mulching will preserve the soil moisture of the *kibanja*.[81]

To enhance the mulching, local communities in the study area use banana stems to increase the water content of the soil in their *bibanja*. Since a large part of the banana plant composes of water, which is approximately 75% and rest 25% of the banana stem is dry matter, local communities in the study area have been chopping banana stems and burying them in trenches. This practice is mainly undertaken during the long drought season and it is considered by the local communities to have increased the water contents within the soil as the banana stems decompose.

**Figure 30: Mulching of the *kibanja***

***Source*: *Fieldwork (2014)***

[81] Interview with Karutanga extension officer on 27th September 2015 at Magata Village (own translation)

***Food reserve***

Long drought seasons mark the onset of food insecurity (*enjala*) within the study area. It was reported during the focus group discussions that food insecurity has been felt in the area during the drought seasons due to crop failure. In responding to this situation, local communities have developed different mechanisms using their indigenous knowledge to enhance food availability within the community. The findings from this study reveal that during a good season, characterised by sufficient rains and high crop yields, it was imperative for the households to store extra harvests such as drained maize, beans and cassava that could serve a purpose during drought season (bad season). Local communities acknowledged that saving food for future use was helpful for households to adapt to food insecurity during the drought season. On the other side, this practice seems to be a challenge especially for the households who sell their food before the drought season in order to fulfil some household basic needs. One participant during the interview in Karutanga Village made the following comment regarding food reserve for the household:

> ……when we have good harvests we try to reserve some food for future use in case the future harvests will not be good. Sometimes we fail to be patient with the income poverty that has been part of our lives; as a result we sell almost all reserved food before reaching the drought season. Most of the times, we are constrained to sell our food reserve to meet different costs such as medical costs and tuition fees for our kids.[82]

Similar observations were reported by Egeru (2012) in his study conducted in the Teso sub-Region, Eastern Uganda. The adaptation practices used by the local communities in that area included; ensuring sufficient food stocks such as cassava garden reserves, dried potatoes, sun-dried cow peas leaves (*eboa*) and livestock. Different observations were made by Songok et al. (2011) in a study conducted in Nandi and Keiyo, Kenya where households overcome food insecurity by, limiting the portion of their meals or even going an entire day without food during times of serious food shortage.

***Undertaking non-farm activities***

Recurrent long drought seasons and the decrease of rains in the study area have reduced agriculture production thus, many local community members have started to engage in non-farm activities such as fish farming, small-scale trading, and selling local liquor/beer. However most notably, many youths have been involved in motorcycle transport (*bodaboda*),

[82] Interview conducted on 28th September 2014 at Karutanga Village (own translation)

brick making and stone quarrying to make a living. In all six villages *bodaboda* and brick making seemed to be the most common alternative jobs amongst the youth. Indeed, it was observed during transect walks and participatory observation that few youths were engaged in farming activities. Almost all the farming activities in the study area were done by elders and mostly women. Many felt that farming was a financial challenge as household savings had to be spent in order to replant to make up for lost yields. This caused majority of local communities to involve themselves in non-farming activities. As stated by Shayo (2006) that in areas where climate change has resulted into recurrent crop failure, it is obvious to find local communities involved in non-farm activities such as business, wage labour, construction works and services to adapt to long drought seasons.

***Worship and pray***

The most significant adaptation practice against prolonged drought and decrease of rains was the practice of worship and prayer. This adaptation practice is undertaken by thousands of Roman Catholic pilgrims who convene at the Nyakijooga shrine in Mugana Parish, Bukoba Diocese every October. Roman Catholics from within and beyond the Kagera Region visit this shrine for worship and prayer seeking deliverance from the problems facing them. One important request presented before the Virgin Mary is relief from the decreased rains and prolonged drought seasons. However, it was also reported during this study that, traditional rainmakers (*Abaiga enjula*) could be consulted to make rain during droughts. This was rarely mentioned by the local community members since modernization has undermined the community's belief on traditional rainmakers, only a few elderly people still have confidence in them.

**Figure 31: Thousands of Roman Catholic pilgrims convene at Nyakijooga Shrine**

***Source***: *Fieldwork (2014)*

***Reducing livestock herds***

Livestock keepers in the study area reported that prolonged drought seasons were causing a decrease of pastures forcing them to walk for long distances searching for good pastures. To cope with this drought, it was found that in some villages such as Magata and Katanga, livestock keepers are reducing their livestock to manageable levels by either slaughtering or selling them. Similar practices were reported by Shemsanga et al. (2010) in which livestock keepers in different parts of Tanzania reduce their number of livestock to adapt to a shortage of pastures and scarcity of grasses. Other livestock keepers were reported to have changed their grazing schedule, whereby during long drought seasons cattle are grazed at night and early in the morning. Different adaptation practices to prolonged drought conditions was reported by Paavola (2008), who found that pastoralist communities in the Morogoro Region migrate from where there is scarcity of pastures to areas that are more pastures.

### 7.3.2 Adaptation practices against pests and diseases

Climate change has accelerated the prevalence of pests and diseases for both crops and livestock in the study area. The data shows that in recent years there have been new emerging pests and diseases, found in the study area. Different adaptation practices have been reported by the local communities to deal with these pests and diseases. But the majority of these practices are highly sensitive to the environment and persisting climate change may render them less effective, needing to be complemented with modern practices.

***Locally made pesticides***

Over the decades most of the local communities in the study area have been using locally made pesticides to kill different pests infesting their crops. Different local pesticides were mentioned by the local communities, for example, a concoction of ashes (*eijwi*) and water that is sprayed into maize gardens to kill pests called *kyambamba*. Other respondents mentioned the use of soil from termite hills (*ekishwa*) to kill different pests attacking crops. Participants also explained a local method of dealing with BXW disease that involves collecting human urine in a bucket and fermenting it for a period of two weeks then mixing with ashes before applying on underground banana stems which has been affected by the disease. However, the majority of the local communities do not use locally made pesticides. Most of the pests which attack various crops in the study area seemed to be resistant to them due to changes in local climate and could not be easily controlled using locally made pesticides. It was reported by the respondents that modern pesticides, have been able to control the spread of various crop pests to an extent. This serves to demonstrate that, in order for local communities to deal with the impacts of climate change, indigenous knowledge must be supplemented with other knowledge. Modern pesticides including DDT and Thiodan have assisted the local communities in controlling pests. The following quote from a member of the extension staff in Missenyi District demonstrates how locally made pesticides are unable to effectively control crop pests:

> Although there are some local community members who still use locally made pesticides to control pests, the majority of them are using modern pesticides. Those who are still reluctant to use modern pesticides have been seriously affected by different pests such as caterpillar and maize stock borer (*ekiuka*).[83]

Kangalawe et al. (2011) have documented how farmers elsewhere in Tanzania have been using indigenous and western knowledge to control crop pests. In their study conducted in Kilolo District, Tanzania, it was shown that maize farmers have generally use pesticides such as Thiodan, DDT and Super Actellic. However, locally made pesticides known as "*Lingategeta*", are made from tubers that are dug from the ground, dried up, pounded, soaked in water and used to spray on crops to kill pests.

On the other hand, controlling livestock pests different indigenous based practices were reported by the respondents to be used within the communities. Most of these practices are still applicable in Haya community. It was reported during the interviews and focus group

[83] Interview with extension staff on 4th October 2014 at Bugorora Village (own translation)

discussions that livestock keepers usually plant certain indigenous trees called baker (*mushunshu*). These trees are planted along the route (*biongolelo*) used by the cattle when going and returning from the pastures. When the cattle pass by *biongolelo,* they scratch themselves on tree bark to control ticks. It was reported that livestock keepers have been practicing zero grazing instead of taking cattle to the pastures in order to avoid pests like tsetse flies and ticks, which have been affecting livestock while there in the pasture areas.

***Hanging seed grains and cereals in the traditional kitchen***

The Haya use a special indigenous method to keep their seeds and grains from being infested by pests. Those seed grains are well packed in a traditionally made container and kept in the kitchen so that smoke from the kitchen will kill the pests that could potentially attack the seeds. During a participatory observation in one of the households, seed grains packed in dry banana stems and hung in the traditional kitchen were observed. The following quotes from the focus group discussions indicate the relevance of this technique in controlling the prevalence of pests, which can attack seed cereal grains:

> In the past I was keeping my seed grains either outside the house or in the sacks. Such type of storage was not good as almost all seeds were affected by various pests. This caused a lot of problems to my household as we didn't have sufficient seed grains for planting. Due to this recurrent problem, I asked my grandmother what to do to overcome this problem. She told me to pack all the seed grains in dry banana stems and hang them in the kitchen. Since I started doing that I have managed to preserve my seed grains from being affected by different pests.[84]

> There are pests which attack cereal crops such as maize and beans after being harvested. After we have harvested these cereal crops, usually we dry them properly before storing them for future use. We dry cereal crops for more than one month. After drying the cereals, we pack them in sacks and hang them in the traditional kitchen to enable smoke from the kitchen to kill different pests, which may affect the cereal grains. Others grind tobacco and put it inside the sack of maize to control pests. However, others burn banana leaves and put the ashes inside the bags of cereal grains to control pests[85].

This data confirms the findings of Shayo (2006) who revealed that local communities throughout Tanzania store their seed grains in kitchens so that the smoke from the kitchen will help to preserve them against seed pests. In this case, the preservation of grains and seeds is accomplished using indigenous skills rather than the modern methods in the country.

[84] Focus group discussion on 12th October 2014 at Kabingo Village (own translation)
[85] Focus group discussion on 8th October 2014 at Bugorora Village (own translation)

***Burning of pastures and farm residues***

The local community members and extension staff identified the practice of burning pastures and farm residues as an important indigenous method of controlling pests, which attack crops and livestock. Burning bushes in pastures for example, has been known to limit the spread of ticks. This was conducted especially during the drought season, in which burning of pastures were possible as all grasses were dry. Although this practice was considered to be important by the local communities, it was found during interviews with villagers and different stakeholders that the burning of pastures in recent years has been prohibited by the government because it destroys the natural ecology. Those who were found burning the pastures faced severe punishment from the government by imposing severe fines to them. The government insists that livestock keepers spray pesticides to control ticks, rather than burning the pastures and bushes. The farmers are also known to burn farm residue the previous season before planting new crops. This practice has helped the local communities to kill various pests, which may affect the crops in the future. Apart from killing the crop pests, burned farm residues have been used as manure as mentioned by one of the participants during focus group discussion in Kabingo Village:

> The burning of farm residue is something I learnt about merely by trying it and seeing what happened. This is entirely an indigenous practice of controlling different pests and increasing soil fertility. Surprisingly, extension staff members do not recommend this practice, and would condemn me if they found out that I'm doing it. I believe this is the best practice available as I can control the prevalence of pests in my crops and at the same time increase the productivity of the soil by adding burned farm residue.[86]

However, one member extension staff in Magata Village explained that burning of farm residues within the farm was not good for soil health; she had the following comment regarding this issue:

> I don't advise my farmers to burn their farm residues on their farms. Undertaking this practice would definitely affect the micro-organisms inside the soil which have an important role in improving the soil fertility.[87]

This practice is certainly useful to the local communities, and when well-managed, it can be more sustainable than using pesticides. However, the burning of bushes and farm residues distorts ecological balance as the temperature can destroy crucial fauna and microbes that are

[86] Focus group discussion on 12th October 2014 at Kabingo Village (own translation)
[87] Interview with extension staff on 24th September 2014 at Magata Village (own translation)

important for sustained fertility and aeration. Furthermore bush burning that is not well managed may release more GHGs to the atmosphere which can impair global initiatives to reduce carbons gases. It is thus clear that indigenous knowledge is necessarily sustainable and can in fact cause problems for the environment (cf. 2.2).

***Early hand-weeding***

Most of the farmers recognize the importance of early weeding on their farms to control the weeds and prevalence of pests. The Haya undertake early weeding using hand at the germination stage. This practice is normally exercised on crops such as maize, millet, sorghum, groundnuts, bambara nuts and beans. Hand-weeding is common and is oldest method of weeding performed by the Haya to control weeds in the *kibanja*. The observations from the fieldwork demonstrated that this practice is still used in many parts of the study area. Although the method is time consuming, it is a temporarily effective but in the long run this method may be impotent hence hoe weeding is required. The majority of participants acknowledged the effectiveness of the hand-weeding if performed repeatedly and carefully. However, it was noted during a discussion with a group of elders, that in recent years the hand-weeding method has become less effective as many households have failed to undertake weeding in the whole *kibanja*. Farmers have complemented hand-weeding with the use of herbicides to destroy unwanted vegetation within the *kibanja* which can have negative impacts on the soil nutrients and cause soil infertility in long run.

***Early planting***

The agricultural system practised in the study area is rain-fed agriculture. The rainfall in the study area is bimodal, whereby there are two rainy seasons. The short rain season (*omusenene*) is from the mid-August to November and the second longer rain season (*toigo*) is from March to June. The short rain season is important for planting seasonal crops such as maize, beans, bambara nuts and ground nuts. In recent years these rains have been unpredictable due to climate change. Discussions with farmers have revealed that in recent years the onset of the rainy seasons have been unusually late, and as a result crops are not being planted accordingly to the normal planting calendar. Most of the crops planted during this time are more susceptible to pests as they thrive in the moisture stress that is caused by the scarce rains. In response, farmers have been sowing their seeds immediately after the start of short rain season, which usually begin around September. These rains in the past were used by farmers to prepare the farming fields. Those farmers who take advantage of the early

short rains have succeeded in reducing their incidences of crop pests leading to higher yields. According to local communities early planting is useful, as it allows crops to receive adequate rainfall and also reduces pest infestations. Many farmers in the study area acknowledged that they apply this practice and that it has helped them to increase yields. As one of the female participant in the focus group discussion in Bugorora Village stated:

> Previously, people were planting their crops after the onset of short rains and the yields were good. But with climate change, the onset of short rains in recent years is usually late. Sowing seeds after the late onset of rains increases the likelihood of the crops to be affected by different pests. Therefore, we have been planting when the early short rains begin around September the period, which previously was used for farming preparations.[88]

However, some participants expressed some concerns about early planting. According to one female participant such practices required early preparation of the farm, which is normally done during the dry season and the tilling the land seems to be the difficult activity due to drought condition. Additionally, since early planted crops mature earlier, they are prone to thieves.

***The use of indigenous medicines***

Participants in all interviews and focus group discussions indicated that they used indigenous plants to cure different livestock diseases. Majority of local communities reported to use different herbs to cure livestock diseases. For example, in case of fever for cattle local communities used a treatment that involved taking bitter leaf (*omubilizi*), mashing, mixing it with water and administering a quantity of half a litre per cattle using a bottle. This concentration reduces the body temperature of cattle. Other plants were used to feed the livestock while simultaneously acting as medicine. For example, the leaves of umbrella trees (*emihumura*) were used to feed goats and treat fever during the drought season. It was expressed by the local community members that during drought seasons there were decreases of milk production from their cattle, so as treatment, a concoction of boiled bitter herb (*omubilizi*) and salt, is given to the milked cattle. Those who have no access to this herb will mix banana peels with salt for their cattle instead.

[88] Focus group discussion with female on 6th October 2014 at BugororaVillage (own translation)

***Selection of indigenous crops and livestock breeds***

Although the local communities have tried to respond to outbreaks of pests and diseases among crops and livestock in different ways, these outbreaks are still widespread. It was found in this study that the persistence of crop pests and diseases has caused many farmers to plant more indigenous crops such as cassava, sweet potatoes, cocoyam and millets. According to farmers, those crops to some extent are more resistant to different pests and diseases which affect the crops. Increased incidences of crop pests have forced the government to seek alternative solutions, which could solve the problem. According to the DAO of Missenyi, incidences of various crop pests and diseases were posing a huge threat to agricultural production in the district. The government in its capacity was striving to find a permanent solution by introducing genetic modified species, which are believed to be resistant to crop pests and diseases. However it was found that the genetic modified crops were affected more by pests and diseases despite being widely adopted by farmers.

However, it was noted that indigenous livestock such as cattle, goat and chicken seemed to be resistant to different pests and diseases. For example, indigenous cattle breeds are resistant to pests and diseases compared to modern dairy cattle breeds. It was reported by livestock keepers that a few years ago, a majority of the people had adapted to modern dairy cattle, which were provided to local communities by the Kagera Small Holder Dairy Extension Project (KSHDEP). Currently, the number of these cattle is quickly falling within the community because they are easily vulnerable to pests and diseases, which has caused many people to switch back to indigenous breeds.

### 7.3.3 Adaptation practices against strong wind events

The local communities noted that recent rains have been accompanied by strong wind events which cause damage to property and farms. In coping with strong winds, the participants of the interviews and focus group discussions cited a number of adaptation practices, which have been applied by the local communities including; undertaking agro-forestry practices, using tree poles to support banana crops and the use of traditional experts.

***Agro-forestry practices***

Many farmers in the study area have begun the practice of planting trees in their *bibanja*, so they can act as wind breakers. Many in the study area have realized that those who have planted trees within their *bibanja* are not as affected by the impacts of strong winds as those

who don't plant trees. Apart from controlling strong winds, local community members also noticed that this practice was helping to shade crops within the *kibanja* especially during the high sunshine season. As noted by Gyampoh et al. (2009), the rural population in Ghana recognized the relevance of having trees on their farms to shade their crops from high sunshine. The practice also helped contribute to soil fertility as when the leaves of the trees fall down, they decompose and increase soil fertility. One participant reflected on this practice as such:

> My son this tree was planted by my father before I was born. When we faced strong winds in 1994 in this village, my *kibanja* was not seriously affected compared to other *bibanja*. I came to realize that it was because of this tree that my *kibanja* had been rescued from serious damage by the strong winds. Soon after this incident, I decided to practice agro-forest techniques in my *kibanja* and now I have many indigenous trees on my *kibanja*, which block the strong winds.[89]

The practice of planting more trees by the local communities was commended by the Environmental Officer of Missenyi District. According to him the decision of the local communities to plant and retain more trees was important as it influenced the microclimate by reducing the wind speed. Although the majority of the respondents spoke positively about agro-forestry in the study area, there is a danger in planting exotic trees, as they can suppress the growth of other crops within the *kibanja*. This was observed in different villages in the study area, where local communities have planted more pine trees within the *bibanja*. Most of pines are not environmental friendly and may add more threats to the *kibanja*.

***The use of tree poles to support banana crops***

Traditionally, the Haya use tree poles to support banana trees when they are carrying a heavy load of fruit. This practice has been commonly used by the farmers to adapt to strong wind events, which may fell the banana trees. Majority of participants in interviews and focus group discussions noted that because of recurrent strong wind events, tree poles were important to support the banana trees and avoid serious damages to the banana plants. It was revealed that some of the local communities were using eucalyptus poles (*omkalitusi*) while others used bamboo poles (*omshekeanda*) and castor poles (*omujuna*) to support banana trees. However, the situation was not simple because the availability of poles within the community was increasingly becoming a problem. Consequently, in the case of strong wind events

[89] Interview conducted on 25th October 2014 at Mbale Village (Own translation)

farmers would lose a lot of immature banana trees due to shortages of tree poles within the community.

**Figure 32: Tree poles supporting the bunch of bananas in the *kibanja***

***Source*: *Fieldwork (2014)***

***The use of supernatural power***

In periods of strong wind events, it was reported by the participants that within the community there are traditional experts who are capable of controlling the strong winds. Most of those experts are elderly people who still believe in supernatural forces. It was reported that those traditional experts use different indigenous practices to control strong wind events in some of the study villages. In case of strong wind events, those traditional

experts usually undertake some traditional rituals to stop the strong wind events within the community. These traditional rituals included taking an empty bottle and filling it with water and put it in front of the house (*omkibuga*) to stop the blowing winds. Similarly, other elderly experts would use throw flaming pieces of fuel wood into the sky and utter a Haya phrase (*kakoma, burungula na nsheshe)* to stop the wind. Another interesting indigenous practice that is based on traditional beliefs was the planting of Napier grasses (*enshagazi*) surrounding the *kibanja* to control the incidents of strong winds that would cause damages to crops. Whereas the elderly population believes in supernatural forces to control strong wind events, others particularly the youths relied on Christian spiritual forces to control the wind. In that vein, one youth participant in the focus group discussion noted:

> I myself believe in God and his son Jesus Christ, I don't believe in these traditional practices. In case of incidents of strong winds, I often take my holy water (*amaizi go omugisha*) from the Nyakijooga shrine and throw in the sky while mentioning the name of Jesus Christ and the Virgin Mary. This has helped me to avoid severe impacts caused by strong winds in my *kibanja*.[90]

### 7.3.4 Adaptation practices in facing water stress

Despite the huge amounts of fresh water available in Tanzania, a large proportion of the Tanzanian population is still faced with water scarcity due to climate change along with other factors prolonging the drought seasons. The situation is worse in rural areas, whereby only a small fraction of rural households can access clean and safe water. Many of the participants in this study recognize that water shortage is a major threat to their life, and have developed several indigenous knowledge-based practices to adapt to this phenomenon, including: rainwater harvesting, water budgeting, planting of environmental friendly trees, traditional taboos and the use of indigenous boreholes.

#### *Rainwater harvesting*

The Haya have been harvesting rainwater since antiquity, with their ancestors refining the art of water resources management over the years. They sometimes collect rainwater directly from the rooftops, and store it in big indigenous calabashes (*ebishusi*) for household use, or in artificial wells constructed in the *kibanja* for use directly within the *kibanja*. Farmers who undertake farming activities within the wetland, especially rice farmers, makes bunded basins also known as "*majaluba*" for water resources management. However, throughout the course

[90] Focus group discussion on the 7th October 2014 at Bugorora Village (own translation)

of this study, it was established that the majority of the local communities in the study area harvest rainwater from their rooftops using gutters and store in buckets and pots. Sometimes rainwater harvested by this technique can be contaminated with a concentration of dusts and mud so local communities use pieces of cloth to filter the water. This finding corresponds with Kibassa (2013) who stated that local communities in Bahi District, Tanzania would hang pieces of clothes on the roof edge to collect and filter the mud and dust in the water before collecting in the buckets. However, during long rain seasons (*etoigo*), where sufficient runoff occurred, local people would co collect water from the runoff. However this is only possible in areas where the soil is not too muddy, and the water collected through this method is mainly used for washing clothes and hygiene.

Despite many local communities relying on rainwater harvesting to cope with water shortages, there are some challenges encountered by the local communities in aptly exploiting this vital resource. It was revealed in this study that the majority of the households had poor knowledge regarding rainwater harvesting and most houses in the study area did not have the necessary infrastructure such as gutters on their rooftops. It was reported during the interviews with local communities that poor infrastructure caused huge loss of rainwater. Most of the houses in study villages were observed having poor infrastructure for rainwater harvesting. In most cases water harvesting gutters of those houses have been placed right at the front of the houses and not on the whole roof of the house.

***Water budgeting***

During long drought seasons the availability of water within the communities often falls short of their needs. Thus some households have had to employ strict water budgeting in order to adapt to these increased water shortages. This practice was largely reported by the participants in Kabingo Village and Mshenyi Sub-Village in Karutanga Village. Participants from these villages unanimously reported that water shortages had changed their water consumption patterns. Thus, any safe and clean water that was available was only used for necessary household consumption such as cooking and drinking. It was reported during the focus group discussion in Kabingo Ward that due to water shortages, villagers could only take a bath once a week, which was an unbearable situation as it could lead to skin disease. However, local communities would reuse the water that had been already used for washing utensils, washing clothes and mopping the house, in order to irrigate some vegetables in the *Kibanja*. This practice is maintained until the onset of rainy season.

***Planting of environmentally friendly trees***

Some participants indicated that water scarcity within the study villages among other things was contributed to by increasing deforestation around water catchment areas. They also mentioned that although in recent years people were actively engaged in tree planting activities, many of the trees planted in the study area were not environmentally friendly. According to local communities some of those trees such as pines, in fact add more threats to the availability of water resources because they consume a lot of water. It was reported that the emphasis has been made starting from the family to the community level that people should embark on planting indigenous tree surrounding water catchment areas to curb water scarcity during dry season. According to local communities indigenous trees do not affect water catchment instead they conserve the catchment. Local communities through their village environmental committees have been planting environmentally friendly trees around water catchment areas. Most of these trees include indigenous species such as umbrella trees, blume moraceae and fig trees. Apart from promoting the planting of indigenous trees, village environmental committees also established environmental by-laws, which guide the management of water catchment areas, particularly in enforcing the conservation of environmentally friendly trees. It is strictly prohibited to undertake any human activities within 60 meters of the water source. It was reported by Magata Village Chairman that the Village Environmental Committee (VEC) of their village has enacted several by-laws and measures to remedy the deforestation around the water catchments. Most of these measures creates an awareness of the effects of deforestation around water catchments, prevented bush fires, promoted the community based management of forests and imposed fines on those who indiscriminately degrade the forests.

It was established in this study that the Missenyi District Environmental Division Office has launched a tree planting competition in order to promote tree plantation and conservation within the community. People who have showed their commitment in planting trees in their plots have been awarded money and certificates to recognize their potential contribution in conservation. In this regard, people have been tempted to continue planting more trees, in turn, the conservation of water resources has improved within the community.

***Traditional taboos***

Traditional taboos are applied to protect natural springs from severe contamination that could lead to water borne diseases during long drought seasons. For example, according to Haya traditional taboos it is forbidden to take baths, wash clothes throw objects, or relieve oneself in the natural springs. The Haya people believe that if you urinate and defecate in the natural spring, you may be attacked by a big snake that is believed to be the king of natural spring. These beliefs are aimed to keep the spring water clean as it is specifically for drinking and cooking. However, it was reported during the interviews that in case of severe drought condition that creates scarcities of water within the communities traditional God (*wamara*) could be consulted asking for the rain. This practice is carried out by a spirit medium (*embandwa*) who gives prayers and offers a sacrifice of a white sheep when the onset of the rains is late. However, obedience to such traditional taboos has lost popularity in recent years within the community due to the pace of modernization, spread of Christianity as well as other external influences. This has caused indigenous knowledge to lose ground (cf. 2.2). This was exemplified by one of the spirit medium (*embandwa*) as follows:

> Contemporary life styles and the spread of Christianity have caused the community to ignore the traditional taboos. Few people, mainly the elderly still conform to the traditional belief systems. When there is a scarcity of rains, some elderly people will convene at my palace to seek assistance of rains. I have been praying in front of *wamara* to ask for the rains, and it rains.[91]

Similarly, Gyampoh (2009) revealed that the increasing heterogeneity of the communities and modernization have reduced the observance of traditional taboos in rural Ghana. This was contributed to by the spread of Christianity, which in turn, paralysed the traditional spiritual institutions as it currently perceived as superstition.

***The use of indigenous wells***

Finding themselves in a precarious position due to environmental and water stress some of the local communities in Muleba and Missenyi Districts have decided to excavate water wells adjacent to their houses in order to have access to water. It was found that this practice was common in the local communities who were living close to wetlands. According to local communities, water shortages have become worse especially during the drought seasons. All natural springs and boreholes dried up leading to the use of water from artificial wells. Although the majority of local communities depend on this water during droughts, it isn't

[91] Interview with *embandwa* on 13th October 2014 at Bwanjai Ward (own translation)

clean and safe. It was reported by study participants in Bugorora, Kabingo and Mshenyi Sub-Village, in Karutanga that many people are succumbing to water borne diseases such as typhoid and diarrhoea after using water from artificial wells. The District Medical Officer (DMO) of Muleba District noted that the number of patients suffering from water borne diseases at Kaigara District Hospital increased during long drought seasons.

**Figure 33: One of the indigenous wells in Kabingo Village**

***Source***: *Fieldwork (2014)*

### 7.4 Interim conclusion

In this chapter it has been demonstrated that the Haya employ a number of indigenous knowledge-based practices in response to the changing environment and climate change. The chapter began with an explanation of the different sources of knowledge on climate change adaptation within the community, and how this knowledge has been developed, shared and passed on to the next generation. The Haya have been integrating this knowledge in their daily practices in order to respond to vulnerability and climate change risks. However, it has been shown that indigenous knowledge alone is currently not sufficient for adaptation

measures to different vulnerability and climate change risks. Therefore, local communities have been forced to integrate their knowledge with other indigenous knowledge or western knowledge from extension staff members and NGOs in order to successfully adapt to climate change. The integration of indigenous knowledge with other knowledge, particularly western knowledge should be done with caution because indigenous knowledge can be easily undermined by western knowledge. As a result, indigenous knowledge may easily disappear within the community due to the hegemony of western knowledge at the local level. However, the use of western knowledge to adapt to climate change risks at local level has shown some weaknesses as it has failed to adapt to the socio-economic realities of the local communities. As a result, some of the climate change adaptation projects have failed due to the exclusion of local communities and their indigenous knowledge. It is therefore important to emphasize that indigenous knowledge should be buttressed, modified or improved in order to develop long-term adaptation practices at local level.

# Chapter Eight

## Indigenous Knowledge: Realizing its Relevance, Hegemony and Challenges in Climate Change Adaptation

This chapter illustrates the relevance, power and challenges of indigenous knowledge in climate change adaptation at the local level. It has been emphasized in literature that effective development planning at the local level should take serious consideration local needs, beginning from the perspective of indigenous knowledge and then seeking important western knowledge not for the purpose of validating indigenous knowledge, but to increase the range of adaptation options at local level (cf. 2.3). Thus, development practices that reflect the needs of the people should follow up a 'bottom-up', rather than a 'top-down approach'. Despite this emphasis, it has been noted that indigenous knowledge has failed to be properly utilized. However, indigenous knowledge that is based on inaccurate beliefs, defective experimentation, or imprecise information can be detrimental in improving the well-being of the local people (cf. 2.2). However, this chapter assesses the power that indigenous knowledge has at local level. It has been noted that there is unequal power relations between extension staff and local people resulted into indigenous knowledge not being sufficiently utilized at local level. Extension staff and experts usually recommend western knowledge as the best practice to climate change adaptation at local level. This chapter concludes by presenting different, often-overlooked challenges of indigenous knowledge, which need to be addressed in order to ensure effective and sustainable climate change adaptation at local level using indigenous knowledge.

### 8.1 The relevance of indigenous knowledge in climate change adaptation

In recent years there have been swiftly mounting interest on the potential role of indigenous knowledge in climate change adaptation. Indeed, more attention to the interplay between indigenous knowledge and climate change adaptation has emerged in the literature over the past few decades (Naess, 2013, p.99). As demonstrated by Berkes et al. (2000) indigenous knowledge entails a hierarchical knowledge practice belief system with knowledge and skills at the lowest level closely connected to management systems, institutions, and worldviews, which are shaped by the local contexts. Therefore, in indigenous knowledge systems the role of knowledge itself cannot be separated from socio-cultural context from which it originated and is used (cf. 2.3). Indigenous knowledge is by its nature concerned with coping with and adapting to different environmental changes, whether climatic or non-climatic, and at

household as well as community levels (Naess, 2013). Different adaptation practices presented in this thesis have shown the linkages between adaptation and indigenous knowledge (cf.7.3). For example, with increased incidences of long drought seasons and reduced precipitation, have forced the local communities to plant more environmental friendly trees. Most of the trees planted in the study area are indigenous species, which are considered non-exotic tree species. The practice of planting indigenous tree species to some extent has played a great role in ecological modification by attracting more rains and acting as wind breaks at the same time. In addition, indigenous tree species have played a greater role in conserving the water catchment areas, which have recently been intruded by pine trees and other environmentally unfriendly trees.

In the study area the government is implementing different agricultural programs such as the District Agriculture Sector Investment Project (DASIP) and the Agricultural Sector Development Programme (ASDP). Both programs put more emphasis on transforming small scale agriculture in order to enhance food security throughout the study area. In executing both programs, the government has been using agricultural extension staff members, the Maruku Research Institute and some NGOs to promote a modernised farming system in the study area. Such a farming system often involves the use of western knowledge, such as the use of genetic modified seeds and fertilizers in order to increase crop yields. Extension and NGOs staffs usually recommend the use of fertilizers to maximize the crop yields in the *kibanja*, and they have been advising the farmers to use herbicides to control invasive weeds such as couch grass (*rumbugu*). The data from this study has shown that most of the farmers do not take the advice and recommendation given by extension staff. The majority of the participants reported using their indigenous knowledge to control invasive weeds. Furthermore, farmers refused to use the recommended fertilizer and herbicides, due to their belief that fertiliser and herbicides reduces the fertility of the soil in the long run. Additionally, the majority of farmers in the study area consider the use of improved seeds or plants such as banana and cassava as inappropriate because they are more vulnerable to pests and diseases caused by climate change. The deficiencies of the improved seeds or plants have been acknowledged by the extension staff, and they have recommended repertoires of solutions to address them including the use of chemical pesticides. Unfortunately the prescriptions recommended by extension staff are more expensive than locally based solutions, which offer better resistance to pests and diseases. Thus, farmers in the study area

have been using indigenous knowledge and practices such as using local pesticides to kill pests and planting indigenous crop species better suited to climate change risks.

It was reported during this study that majority of the farmers were saving a lot of money as instead of using the recommended rates of fertilizer from extension staff, farmers had developed indigenous ways of managing and improving the fertility and moisture of the soil. As we have seen in the previous chapter (cf. 7.3), farmers were undertaking fallowing and agro-forestry to improve soil fertility. In addition, the farmers planted cassava because it is drought resistant, it is not a heavy feeder and when its leaves fall, they decompose and increase the soil nutrients and productivity. However, farmers in the study area undertake mulching of their *bibanja* in order to increase the fertility of the soil and to control weeds infestation. This is an old traditional practice carried out by local communities in the study area that is very common. They believe that mulching maintains the soil moisture especially during long drought seasons and once the mulched grasses decompose increase the soil fertility. The Haya farmers through their long experience know that mulching of the *kibanja* with grasses throughout the year increases the fertility of the soil. It was reported during the interviews that at harvest, banana stems are cut at a certain height and left as mulch in the *kibanja* so that when the banana stem has decomposed it increase the fertility of the soil and enhances the soil moisture during long drought seasons. On the other side, livestock keepers reported that indigenous knowledge is cost effective in adapting to climate change. Livestock keepers have alternatives to modern drugs, using locally available plants such as bitter leaf (*omubilizi*), pepper (*obuguruma*), baker (*mushunshu*) and Aloe vera (*Nkaka*). All these indigenous plants have been helpful in adapting to incidences of different pests and diseases caused by climate change, which affects the health of livestock. The use of indigenous plants helps to save money that could have been spent on drugs from veterinary pharmaceuticals.

Until lately, cultural milieus have been largely ignored in studies of indigenous knowledge and adaptation to climate change (Stuckenberger, 2009). Recently however, the cultural aspects of climate change adaptation are increasingly being considered ( Roncoli et al. 2009; Leonard, et al. 2013). While Culture and taboos have been shown to potentially assist in protecting water catchments and forests in the study area, other scholars have argued that culture and taboos may present obstacles to successful adaptation to climate change (Nielsen and Reenberg, 2010; Leck et al. 2011). This study has engaged in a critical understanding on how traditional cultural beliefs and taboos have played a great role in climate change

adaptation. It has been reported by the participants of this study that some local communities still are practicing traditional rituals, which have generally assisted them in adapting to climate change. For example, in the study villages there are big indigenous trees (*emirindu*), which have been conserved by the communities specifically for cultural activities. In turn, those trees have played a great role in modifying the local climate. In villages where those trees are preserved, rain scarcity is not a serious problem compared to those villages where such trees have been cleared. Incidences of strong wind events have been more severe in villages where there are no big indigenous trees as they act as wind breakers. Traditional culture and taboos have also played a significant role in conserving water catchment areas in the study area. The Haya have specific taboos which help the community to manage their water resources. For example, Haya culture and taboos do not allow any person to bathe, nor wash clothes or dishes in a natural spring. This is because water from the natural spring is used specifically for drinking and cooking. In practice, the Haya have categorised their water sources in two groups: the natural springs (*enchuro*), whereby water is used by the household for drinking and cooking; and rivers and streams (*ekyogo*), in which water is used for washing clothes, bathing and watering animals.

In the study area and the whole country at large, indigenous knowledge is increasingly considered to be on-par with western knowledge because numerous ideas in indigenous knowledge that were perceived as primitive, backward and misguided are now regarded as relevant and appropriate. Various extension and NGOs staff acknowledged that indigenous knowledge has an important role in climate change risk adaptation. It was revealed during the interviews and focus group discussions that during an outbreak of diseases in livestock or crops, local communities would respond first by applying their indigenous knowledge. Then later, if the problem escalates, local communities could seek further scientific solutions in order to back up indigenous knowledge. For example, some livestock keeping communities were reported to use double concentrations of bitter leaf (*omubilizi*) in order to reduce the body temperature of the cattle. If the cattle did not recover, then a veterinary expert may be consulted to inject the cattle with vitamin D3, calcium and phosphorus to control fever. Thus, local communities sometimes apply different forms of knowledge that are useful to them and do not only depend on indigenous knowledge (cf. 2.1)

It has been reported widely in different studies that the failure of different development projects has been caused by a lack of community participation (Chifamba, 2013). Many

different environmental and resource management projects marginalize cultural factors and indigenous knowledge, which leads to the complete failure of those projects (see Chaudhury, 1993). Though economic development is needed per se it does not necessarily constitute sustainable development, rather, it must be connected to a set of well-defined social and cultural objectives that situate culture and people first (cf. 2.4). Furthermore, development interventions such as the prevention of environmental degradation, conservation of limited natural resources, adaptation to climate change and so forth, have different ramifications in terms of culture (see Dube, 1991). Thus, any plan to improve the quality of life of the local people will be ineffective if it does not acknowledge the cultural values, knowledge and participation of the local people. The use of indigenous knowledge in climate change adaptation provides apt mechanisms for a participatory approach, which is a major requirement for the sustainability of any project at the local level. Any climate change adaptation project at the local level should see the local population as partners in the project, with mutual ownership (cf. 2.2). This study revealed that different climate change adaptation projects, which integrated local communities into their design and implementation, were very successful. One of the successful adaptation projects initiated by the government to the local communities was the adoption of new banana species such as *fhia-2, fhia-17* and *fhia-23*, which have become commonly grown banana species in the study area. These species have been grown together with indigenous bananas in order to cope with the decrease of the productivity of the *kibanja* due to climate change.

The indigenous knowledge system in the study area continues to evolve, as it is shared and transferred from one generation to another within the community. Parents train their children from birth to use this knowledge by undertaking different experiments and observations. Through those experiments and observations, the children are able to gain indigenous knowledge and skills that will help them to adapt to future uncertainties (environment, economic or socio-cultural). To ensure that children understand the indigenous knowledge, some parents have been making sure that their children participate in daily farming activities and learn by doing (cf. 2.4). This has helped children to learn different indigenous knowledge-based adaptation practices, and enhance their future adaptive capacity to climate change. These practices include cultivation of wetlands during drought seasons, searching for indigenous medicinal plants, packaging of cereals in indigenous containers for future use, mulching of the *kibanja*, as well as pruning old banana leaves and dry stems in the *kibanja*. The learning process through the experimentation and observation of indigenous knowledge

starts between the ages of four to ten. However, due to severe recurrent consequences of climate change in the study area, it was revealed that local communities are undertaking continuous experiments to update their indigenous knowledge and practices, which have helped them to adapt to vulnerability and climate change risks (cf. 2.1). Indeed, updating indigenous knowledge is of great relevance due to recurrent impacts of climate change. It is difficult for farmers to support their livelihoods by depending only on the past practices.

### 8.2 The hegemony of Haya indigenous knowledge

The findings from this study have revealed that there is a power struggle that exists between extension staff and local people when deciding what type of knowledge should be used to adapt to climate change. It was revealed that extension staff who usually work with local communities, promote the use of western knowledge in climate change adaptation; hence demonstrating a preference toward western knowledge over Haya indigenous knowledge. Consequently, western knowledge has dominated indigenous knowledge, and local communities must follow the recommendations of the extension staff and experts. It has been noted that many of the climate change adaptation strategies suggested by the extension staff are not based on the socio-cultural context of the Haya. Most of these strategies promote market oriented economic growth through top-down approaches. Those approaches are implemented by the Tanzanian Government and its development partners. Adaptation strategies grounded in top-down approaches emphasize capacity building of the local communities, which is carried out through training, in order to expose the local communities to western knowledge. District authorities through their extension staffs have banned the growing of certain indigenous crop species, wetland cultivation, and the practice of burning farm residues to kill crop pests. They predominantly emphasize planting of improved seeds and plants.

It was reported by the participants during the interviews that in most cases local communities stick to indigenous knowledge and practices. It is rare for local communities to follow the recommendations given by extension staff, one of the few examples being, the planting of improved crop varieties such as improved banana species. Many local community members expressed their concern over costs, which they would have to incur if they opted to use western knowledge for climate change adaptation. Most of the chemical pesticides and improved seeds recommended by the extension staff and NGO experts were too expensive for the local communities to afford. Thus, they planted crops for their household consumption

that do not require the use of chemical pesticides, such as indigenous cassava, indigenous maize, and indigenous banana, which reduced the production costs. Livestock keeping communities were using indigenous plants to cure different livestock diseases thereby avoiding more expenses that could be incurred in seeking western treatments. Additionally, different pests attacking cattle such as ticks (*embala*) were killed by hand as it is a more cost effective method than spraying western medicines.

Thus, indigenous knowledge has helped the local communities to reduce their dependence on western knowledge which local communities have no control over and cannot afford. The decision made by the local communities in the study area to continue using their indigenous knowledge for climate change adaptation, has reduced the power exercised by extension staff and NGO experts. The findings of this study have revealed that by using indigenous adaptation practices, local communities are able to maintain their agency. However, the space and power of knowledge may yield conflicts between local communities and extension staffs. This conflict may arise when both parties are struggling to gain space and hegemony on climate change adaptation initiatives at the local level. Extension staff expects that local communities will easily adopt their recommendations. This means that local communities would be moved under the dominion of the extension staffs. Such expectations are not practical for local communities as they strongly argue that using western knowledge is expensive and environmentally unfriendly.

However, the Tanzanian government alongside its development partners have continued to provide funds to support the teaching of western knowledge in the study area. It has been noted by this study that these programs have not completely helped the local communities to effectively adapting to climate change as western knowledge is not embedded into the socio-cultural context of the Haya (cf. 2.4). Therefore, it should be noted that climate change adaptation initiatives at the local level must integrate the Haya indigenous knowledge systems, so that extension staff members can learn what local communities already know about climate change adaptation. This will enable effective and sustainable climate change adaptation at the local level.

### 8.3 Challenges to sustained use and application of indigenous knowledge

It is misleading to think of Haya indigenous knowledge as always correct or sustainable. The data of this study reflects the theoretical perspective of this thesis that indigenous knowledge has a number of weaknesses (cf. 2.2). The results of this study have revealed a number of

different challenges have been encountered by the local people regarding the use and application of indigenous knowledge in climate change adaptation. These challenges include: the poor reputation of indigenous knowledge; the decrease in the custodians of indigenous knowledge; the absence of knowledge sharing culture; the on-going socio-economic transformation; the loss of traditional culture and practices; unevenly distribution of indigenous knowledge; disappearance of indigenous seeds, plant species and traditional medicine; and exclusion of indigenous knowledge in the formal adaptation practices.

### 8.3.1 Poor reputation of indigenous knowledge

One of the main challenges for indigenous knowledge is its poor reputation within the community as it is widely perceived as being outdated. During interviews and focus group discussions participants would often associate this knowledge with witchcraft. Different cultural practices and taboos embedded in the indigenous knowledge such as rain seeking, and stopping strong winds are still performed by a few individuals, generally the elders, within the community. Most of the elders who perform those practices are considered by the community to be wizards (*abalogo*), a term which carries negative connotations. As a result, rainmaking experts within the community cannot perform their duties openly since they do not want to be called wizards. Poor recognition of indigenous knowledge has caused increased demolition of all important traditional sacred places used for worship in the past such as big indigenous trees (*emirundu*), in which all traditional rituals and worship activities were carried out.

In years past, traditional healers were highly respected by the community, however this is no longer the case. Similarly, due to the lack of respect of the traditional culture and taboos that exists in the communities, most of the elders who are the custodians of this knowledge are less willing to share this knowledge with the younger generation. It was found that the current generation is not interested in indigenous knowledge due to number of factors including: modernization, the spread of Christianity and their formal education system. Most youths who were interviewed were of the opinion that indigenous knowledge is outdated, and cannot solve contemporary problems. However, on the other side, the government has failed to recognise and support indigenous knowledge, because there is no political will to do so and there are no state mechanism to document indigenous knowledge within the communities and disseminate it across the generations.

### 8.3.2 Decrease of the custodians of indigenous knowledge

According to local community members in the study area, the custodians of indigenous knowledge within the community are decreasing quickly. Most of these custodians are elders (*abagurusi*) who are near the end of their life. It was noted that if a community had a large number of elderly people available, it was considered an asset, because they could be consulted and give advice on how to respond to the different environmental uncertainties occurring in the village. Some of the participants of this study were concerned about whether this knowledge would continue to exist in the coming decades, since the custodians of the knowledge were decreasing in number and the knowledge is not well documented (cf. 2.2). In some of the villages it is difficult to find an elderly person from 70-90 years old. However, it was noted that due to poor health care facilities in the study area and the country at large, elderly people do not live long in recent years. In fact, the current life expectancy of Tanzania is 61 years old (see URT, 2012). It was also revealed by this study that there was no initiative to report Haya indigenous knowledge to the outside world, thus most of the knowledge was to remain location specific (cf. 2.2).

### 8.3.3 Absence of knowledge sharing culture

Local communities in the study villages were concerned about the pace of knowledge sharing within the community. It was reported during the interviews and focus group discussions that the knowledge sharing processes within the communities were very ineffective. There was little cooperation between different social groups of farmers and thus knowledge was not shared between them. Hence, knowledgeable farmers within the community did not share their knowledge with less knowledgeable farmers. This was contributed to by the lack of unity, a trait that had existed within the communities in the past. Farmers used to share seeds, and farming practices to improving the productivity of the *bibanja*. Different problems encountered by the local communities such as environmental changes were solved collectively by all members of the community. This enhanced knowledge sharing within the communities since people worked together. However currently, problems are solved individually within the community and not collectively (cf. 5.3.4). This has restricted the sharing of indigenous knowledge effectively within the community and as a result, people have failed to adapt to climate change. In addition, it was noted that within the Haya community some of the traditional customs and taboos practices such as curing of diseases, rain making were transmitted through inheritance or in specific clans, hence difficult to share with the whole community.

### 8.3.4 Socio-economic transformation

The evidence depicts that in recent years there is a pressure on the Haya to integrate with larger societies. This pressure is often great, and it has caused the Haya to integrate more, which in turn has caused the social structures that generate Haya indigenous knowledge, and practices, to fall apart. Furthermore, the growth of national and international markets, the imposition of formal education and religion as well as the impact of different development processes within the Haya communities, have caused indigenous knowledge to be exposed to western culture. As a result, Haya indigenous beliefs, customs, values, know-how and practices are being changed and subsequent generations will not learn the same knowledge as their ancestors (cf. 2.2). It was reported by the participants that it is difficult to rely on old practices to adapt to climate change given the fact that knowledge of the past cannot adapt to current environmental changes. This was illustrated by one of the farmers in Katanga Village in the following quote:

> ……nowadays it is difficult to control different pests which attack maize by merely using a mixture of ash and soil. In the past it was possible because the type of pests which existed were not resistant. With the current environmental changes, it is difficult to depend on this practice as most of the pest are resistant to indigenous knowledge based practices. We are mostly using modern pesticides which seem helpful[92].

Some of the farmers expressed the concern that the integration of the Haya with larger societies has shifted them away from planting only indigenous crop species. It was noted during the focus group discussions that in recent years the Haya have transformed their indigenous banana farming system and have started to grow other crops. Traditionally, the Haya only grew indigenous bananas for food and to sell. Due to economic transformations and environmental/climate change, the Haya are increasingly involved in farming new crop species, such as rice, sunflowers and potatoes. This has impaired some of the indigenous adaptation and practices which relied on indigenous banana. For example, the traditional worship to ancestral spirit in asking for the rains under the big trees (e*mirundu*) was done using local beer (*olubisi*) to appease the ancestors. Due to decrease of production of indigenous banana within the community has also affected the production of local beer.

[92] Interview conducted on 25th September at Katanga Village (Own translation)

### 8.3.5 Vanishing of traditional culture and practices

Local communities in all study villages have stated that traditional cultures and practices had disappeared within the community. This has negative impacts on the sustainable use of indigenous knowledge within the community. Different factors which contributes to vanishing of traditional culture and practices within the community were mentioned by the local communities during the interviews and focus group discussions. These are: modernization/westernization, an increase in population, and the adoption of formal education. It was noted that one of the factors that contributed to the population increase in Muleba District was the increase of immigrants from *sukumaland* mostly from Mwanza and Geita Regions. Majority of the participants in this study reported that immigrants from these regions came with their cultural practices, which were contrary to Haya cultural and taboos. Most of these immigrants eventually married some Haya women and men and as a result, contributed to the waning of Haya culture and practices such as team work as well as the sharing of seeds and animal breeds, which are hardly implemented within the community anymore. Moreover, the study area was among the first places in Tanzania to be settled by missionaries who established plantation agriculture while emphasizing the use and application of western knowledge in different farming and livestock keeping activities. This had undermined important indigenous knowledge of the Haya, particularly those practices related to climate change adaptation. Technology such as TV and radio has also contributed to this disappearance as observed by the absence of the indigenous dances and songs, which are hardly seen within the communities in the present era. However, it was reported during the interviews that some important agricultural activities such as long-term fallowing was disappearing within the Haya communities because of excessively population growth, which culminated into land pressure.

### 8.3.6 Unevenly distribution of indigenous knowledge

The data has shown that indigenous knowledge is not evenly held among the farmers and livestock keepers within communities due to different factors such as level of experiments by local communities, past experiences and gender. This makes it difficult for this knowledge to be sufficiently integrated across the community (cf. 2.2). It was found during interviews with elders that indigenous knowledge production within the community depends on the level of experimentation undertaken by individuals. Local communities undertake many experiments regarding crop and livestock management, particularly when they are confronted with climate change. It was reported that farmers in the study area have conducted some experiments

concerning the time of planting of crops and found that utilizing early short rains helps to avoid pest and disease damage as well as increase yields. Therefore, farmers who frequently conduct experiments have more knowledge than those who do not. It was further reported during interviews with elderly residents that a lack of past experience among the local communities was an obstacle to successful climate change adaptation using indigenous knowledge. For example, farmers who had extensive experiences with rain patterns have more knowledge on how to adapt to situations of scarce rains. This was illustrated by one of the farmers in Bugorora Village in the following quote:

> ……for those aged farmers who have valuable experiences regarding the weather patterns are most likely to adapt to climate change successfully than those who have not. There are elders in this village who are able to forecast the seasons throughout the year. They can tell you whether short rain season in this year will be sufficient or not just by using indigenous weather forecasting indicators[93].

It was reported that most of indigenous knowledge were known to women who mainly deals with a farming activities. Most of the women who involve themselves in day to day farming and livestock keeping activities were knowledgeable in adapting to climate change impacts using indigenous knowledge. It was revealed during the interviews with selected women that they were more knowledgeable to compare with men because most of these women are closely involved to farming activities than men. This has caused unevenly distribution of indigenous knowledge within the communities.

### 8.3.7 Vanishing of indigenous seeds, plant species and traditional medicine

One critical challenge to the use indigenous knowledge in the contemporary community is due to the disappearance of indigenous seeds, plant species and traditional medicine in recent years. It was reported by the participants of this study that, due to the increasing tendency of extension staff to discourage and ban indigenous seeds and plant species, it is difficult to adapt to a long drought season by planting indigenous drought resistant seeds and plant species. Additionally, local communities reported that indigenous medicinal plants had disappeared due to a number of factors, including: the recurrent drought condition; population pressure; and migration from one place to another. This makes difficult the application of indigenous knowledge in different farming systems and livestock keeping among the local communities. This in turn has caused disappearance of most of indigenous knowledge-based practices within the communities.

[93] Interview conducted on 10th October 2014 at Bugorora Village (Own translation)

### 8.3.8 Exclusion of indigenous knowledge in the formal adaptation practices

The data has shown that indigenous knowledge is not sufficiently integrated in the formal climate change adaptation strategies in Tanzania. As a result, the pivotal role of this knowledge in climate change adaptation at local level is not well known. It was noted during interviews with extension staffs in both districts, that during their work with local communities, indigenous knowledge was rarely considered. For example, one of the extension staff members in Magata Village advised the farmers and livestock keepers to use modern knowledge to adapt to different pests and diseases which attack crops and livestock. The following quote form the base of this example:

> Most of the pests and diseases which attack crops and livestock seem resistant to indigenous knowledge and practices. Some of the farmers who still use indigenous medicinal plants to cure diseases have reportedly lost a number of cattle and goats. In such circumstance I cannot advise them to continue using indigenous medicinal plants, rather than advising them to use western knowledge embedded in modern technology[94].

Despite such exclusion of indigenous knowledge in climate change adaptation, some of the extension staffs were very concerned with the government failure to incorporate this knowledge in climate change adaptation, particularly at the local level. They felt that it would have been worthwhile if this knowledge is researched, documented and validated that it can help in climate change adaptation initiatives.

## 8.4 Interim conclusion

This chapter has illustrated that indigenous knowledge held by the Haya is important to the local communities not only because it is available at the local level, but because it is embedded in their socio-cultural context. The important role that indigenous knowledge has played in climate change adaptation at the grassroots level makes this knowledge relevant for the Haya not only in adapting to climate change, but adapting to other socio-economic changes emerging from the community. The main challenge with this knowledge is that it is location specific and hence potentially inapplicable beyond the context of the Haya. It has been shown in this chapter that the spaces and power of Haya indigenous knowledge is undermined by the extension staff, who promote the use of western knowledge for climate change adaptation. However, local communities sometimes resist the recommendations given by extension staff due to the large expenses associated with using western knowledge and the lack of control local communities have over western knowledge. It is therefore important that

[94] Interview with extension staff in Magata on 26th September 2014 (Own translation)

any effort to address climate change impacts at the local level first engages with those local communities who are seriously affected, starting with the perspective of indigenous knowledge and then seeking relevant western knowledge, not to authenticate indigenous knowledge, but to enlarge the range of options for action (see also Mistry and Berardi, 2016). This will eventually make western knowledge more acceptable to the local communities that it seeks to support, while effectively helping those communities adapt to climate change.

# Chapter Nine

# Summary and Conclusion

The aim of this study was to find out how the Haya experience and adapt to vulnerability and climate change. In particular, this study has sought to understand the adaptation practices of the Haya in the absence of western knowledge. One of the main arguments of this study is that indigenous knowledge is not something good in itself, rather it is important to scrutinize its potential with regard to climate change adaptation, and to analyse how practical and useful it is at the local level on a day-to-day basis. In so doing, existing tension between indigenous and western knowledge can be ignored in favour of advancing areas where indigenous knowledge donates successes to climate change adaptation. This study was motivated by my own observation of recent on-going changes, particularly climate change, which has affected the livelihood of the Haya. In recent years, the Haya have continuously suffered from recurrent long drought seasons, reduced precipitation and recurrent strong wind events, which greatly affect the livelihood systems of the community. However, other factors identified by the local communities and the available literature have affected their livelihood systems, these include incidences of pests and diseases in both crops and livestock. Incidences of pests and diseases have caused food insecurity within the study area in recent years. While facing these changes, the Haya were able to develop various indigenous knowledge and practices to adapt to them. Most of these adaptation practices have assisted the Haya in responding successfully to climate change, but some have failed due to a number of factors.

## 9.1 Summary of the findings

This study was defined by four conceptual pillars, which underpinned the empirical chapters of this thesis (cf. 2.9). The first conceptual part aimed to delve into various on-going changes (climatic and non-climatic), which have been observed by the local communities in recent years. Understanding the different on-going changes was vital in assessing different sources of vulnerability hence, starting-point vulnerability was used in order to understand how different on-going changes have contributed to the vulnerability of the community. It was further noted that community vulnerability in the study area is not limited to climate change, but it is also caused by various socio-economic dynamics within the communities. Although socio-economic changes seemed beneficial to climate change adaptation initiatives to some of the local communities, this study showed that some socio-economic changes have impaired the adaptive capacity and coping mechanisms of the Haya. Furthermore, this study

has demonstrated that many on-going changes have contributed to food insecurity and the poverty trap within the community. Some of the most important changes, according to local communities, were in the agricultural sector. Although the agricultural sector is believed to be a crucial sector in improving the livelihood of the Haya, the findings show that in recent years the performance of this sector has been shrinking. There have been a number of factors reported by the participants of this study to have contributed to the failure of this sector and hence food insecurity and poverty. For instance, the evidence shows that, in recent years the Haya have experienced a decrease of *kibanja* productivity making it difficult for the households to depend on the *kibanja* to get food. This situation is starkly different from the past 30 years, whereby the productivity of the *kibanja* was high, and households could survive on the yields from their *bibanja* alone. The current situation is that local community members have been begun purchasing food from kiosks and shops available within the village. This increased dependency on the shops and community kiosks has intensified the decrease of *kibanja* productivity, because many local community members have abandoned their *bibanja* and started working paid jobs in order to get money for buying food. The underlying factors for the decrease in productivity of the *bibanja* include: a decrease of soil fertility and the lack of youth working in the *kibanja*. Additionally, incidences of banana pests and diseases contributed to lowered productivity in the *bibanja* as bananas are the primary crop that is grown on the *kibanja*. The most serious disease mentioned by the participants of this study was BXW or *mnyauko*. The prevalence rate of this disease within the study area was to be so high some of the farmers were withdrawing from banana farming altogether.

Land use changes also contributed to agricultural changes in the study area, whereby the traditional Haya farming system was being ignored (cf. 5.1.3). Land use changes contribute to soil infertility which decreases agriculture production. In addition, the majority of the rural poor in the study area have been left with no access to land, where they can undertake their supplementary farming activities during long dry spells, since large tracts of village land have been either converted into protected areas or leased to individual investors. This situation has contributed to food insecurity and poverty among the local communities in the study area (cf. 5.1.4). It was further reported during the interviews and focus group discussions with the local communities that market access problems, the decline of farm earning income and food price volatility were some of the economic changes that had contributed to community vulnerability. Some of these economic changes manifested themselves due to agriculture

failure, which caused a decline in farm earning income (cf. 5.2). Other important changes that have been observed by the local communities in the study area are the socio-cultural changes of the Haya. It is apparent that changes in the socio-cultural context of the Haya have impaired their capacity to withstand uncertainties, particularly climate related risks. Different factors were cited during the interviews that contributed to the socio-cultural changes of the Haya, such as: behavioural changes, the spread of Christianity, the change of indigenous belief systems, the decline of customary institutions, and the decline of community solidarity (cf. 5.3). It has been depicted by the findings of this study that local communities put climate change at the centre of community vulnerability. It was also found that climate change intersects with other non-climatic changes to produce community vulnerability (cf. 6). This was observed in numerous study villages, whereby many of the impacts such as the decrease in productivity of the *kibanja*, land shortages, BMX disease, and food insecurity were more pronounced during long drought seasons.

The second conceptual pillar focused on understanding the local community's perceptions of the local climate including their future projections according to their daily experiences and knowledge. This was done in order to understand the way that the local communities make sense of what they observe and how they take action. In order to understand the local community's perceptions, three elements of weather were focused on, namely: rainfall, temperature and winds. These elements were considered by the local communities to be important in their daily livelihood activities. The findings revealed that (19.9%) of the respondents had no knowledge regarding climate change. This probably was due to an inability to get access to scientific information on climate change within their village and the region at large. The evidence from the local communities shows that in recent years the rainfall amount had been decreasing and the onset of the rainy seasons had been late. This had negative implications for agricultural production, eventually resulting in food insecurity and poverty. Recurrent long drought seasons were reported by the majority of the participants of this study. These incidences have contributed to moisture stress, repeated crop failures, and water scarcity. The local communities also perceived that incidences of strong winds had been increasing in recent years. Strong wind events were reported in all six villages and have caused damage to crops.

The third conceptual pillar endeavoured to identify and document indigenous knowledge and adaptation practices exercised by the Haya people to respond to climate related risks. Most of

these adaptation practices are based on indigenous knowledge, which is entrenched in the socio-cultural context of the Haya. Indeed, it is difficult to disentangle Haya indigenous adaptation practices from their traditional customs and taboos (cf. 7.3.4). However, the data has shown how indigenous knowledge is learned and shared from generation to generation (cf. 7.1 and 7.2). Although indigenous knowledge played a great role in climate change adaptation among the Haya, this knowledge was in danger of being lost, as most of the elderly custodians of this knowledge were dying off within the community. Unfortunately, there is no plan put in place by either the local communities or the government to document this knowledge for future generations.

The last conceptual pillar sought to demonstrate the relevance, hegemony and challenges of indigenous knowledge on climate change adaptation at the local level. The data showed that indigenous knowledge has been playing a large role at local level, in which enables the Haya to respond to different environmental changes. Despite the crucial role of indigenous knowledge at local level, its space and power is threatened by extension staff and experts from NGOs who often promote the use of western knowledge for climate change adaptation. This in fact has undermined the use of indigenous knowledge at the local level, particularly among the current generation. Despite this, the majority of local communities have resisted following the recommendations made by extension staff and experts. These recommendations are derived from western knowledge, and are often more expensive and less environmental friendly than indigenous solutions and local communities have no control over their implementation. This has created more spaces and power for indigenous knowledge at the local level. Although over-romanticization character of indigenous knowledge being good not only to climate change adaptation, but to all development practices at local level, this thesis has critically discussed the challenges of this knowledge system in climate change adaptation at local level. Different challenges including poor recognition of indigenous knowledge, decrease of the custodians of indigenous knowledge in the community, absence of knowledge sharing culture, and loss of traditional culture and practices are among of the few barriers for successful application of indigenous knowledge in climate change adaptation at local level.

## 9.2 Contribution of the study and theoretical implications

This study sought to assess the use of indigenous knowledge in climate change adaptation at the local level. The findings of this study were significance as they provided empirical evidence of how indigenous knowledge can be used to adapt to vulnerability and climate

change for improved rural livelihood activities. There exists a great deal of theoretical studies on the role of indigenous knowledge in development in the context of developing countries, which have little empirical evidence on climate change adaptation. Many of these studies romanticize indigenous knowledge as something that should always be integrated into climate change adaptation at local levels. This study has tried to critique this wide perspective by showing that indigenous knowledge has many over-looked features, which need to be taken into consideration. There are a number of indigenous practices based on problematic beliefs, mistaken experiments, and inaccurate information which can cause harm to people (cf. 2.2). Very few studies have been done about Haya indigenous knowledge on climate change adaptation. Previous studies in the Haya community had focused on the cultural aspects of the Haya (see Kilaini, 1990; Rweyamamu, 2012; Kashaga, 2013). The findings of this study were of significance as they provided a framework on how indigenous knowledge can be used in climate change adaptation at the local level, while taking into consideration many frequently over-looked negative features of such knowledge.

The study concurs with the recommendations made by other studies on indigenous knowledge carried out in different places in Tanzania (see Mapinduzi et al. 2003; Mbilinyi et al. 2005; Lwoga, 2009; Kangalawe et al. 2011; Naess, 2013; Elia et al. 2014). Generally, all these studies suggested that there should be deliberate efforts towards identifying, validating and documenting important roles, which indigenous knowledge may contribute to development, particularly in climate change adaptation. Moreover, Chang'a et al. (2010) argued that systematic documentation of indigenous knowledge and its incorporation into scientific weather forecasting systems is needed to enhance the accuracy of seasonal rainfall forecasts under a changing climate. The findings of this study therefore provide an approach that can be applied to improve indigenous knowledge adaptation practices at the grassroots level in Tanzania and globally.

The findings of this study are relevant for policy makers in Tanzania, who, in recent years, have started to realize the necessities of identifying existing indigenous knowledge, integrating it with western knowledge and recognizing its role in development. Indeed, numerous previous studies have been paid more attention to the political, economic and social facets of the development process, and less attention to the cultural facets of it. It was from this backdrop that this study adopted the Situated Learning Theory (SLT) in order to understand how indigenous knowledge as a socially constructed process, was acquired,

shared within the Haya community. As discussed earlier in this thesis (cf. 2.4) indigenous knowledge is embedded in the socio-cultural context, in which it emanates. Thus, using this theoretical approach has aided in identifying existing Haya indigenous knowledge, which is being produced within the community through daily interactions with their environment, cultural contexts, as well as social relations. This is helpful for policy makers in Tanzania when planning for climate change adaptation strategies at local levels, as they have to take serious consideration of the socio-cultural context and specific artefacts of the Haya for successful climate change adaptation at local level.

### 9.3 The direction for further study

This thesis investigated the role of indigenous knowledge in climate change adaptation at the local level. As presented in chapter 5 of this thesis, in recent years the Haya have experienced different on-going (climatic and non-climatic) changes, which contribute to their vulnerability. Since one of the central objectives of this study was to unearth available indigenous adaptation practices for climate change, it is therefore important for future studies to identify the Haya indigenous adaptation practices for non-climatic changes. However, this study has demonstrated the existing power imbalances between extension staff and local communities, which in turn has undermine the pivotal role of indigenous knowledge in climate change adaptation at the local level. Extension staff usually promotes the use of western knowledge and discourages the use of indigenous knowledge at the local level for adapting to climate change. This has caused indigenous knowledge to be insufficiently integrated into formal adaptation practices to climate change in Tanzania. It is therefore recommended that further studies be conducted to assess how to enable the effective integration of indigenous knowledge into future programs and policies regarding climate change adaptation in Tanzania.

Similarly, it has also been shown that the pace of modernization has impaired the use of indigenous knowledge within the communities. Furthermore, the current socio-cultural transformation caused by external influences has also undermined the Haya indigenous knowledge systems. It is apparent that the majority of the local communities, particularly the current generation has negative perceptions of indigenous knowledge. Most of them associate this knowledge with witchcraft; hence any attempt to apply this knowledge in different activities especially climate change adaptation could lead to accusations of witchcraft. Such negative perceptions of indigenous knowledge have caused this knowledge to be either

marginalized or scarcely integrated into formal climate change adaptation initiatives in the contemporary era. It is therefore recommended that more studies be conducted to scrutinize the applicability of this knowledge in the contemporary era and integrate it with western knowledge for climate change adaptation at the grassroots level.

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**ANNEX**

**Annex 1: Household questionnaire**

**Location of interview site:**

Interview Number: | | |

District: _____

Location (ward, village and sub-village): _____

**SECTION 1: General information of the respondents**

**Please answer the following questions openly and circle the correct answer**

1. Sex (a) Male (b) Female
2. Age (a) 18-25 (b) 26-33 (c) 34-41 (d) 42-49 (e) 50-57 (f) 58 and above
3. Education level of the respondents
   (a) Illiterate (b) Adult education (c) Primary education (d) Secondary education
   (e) Others specify……..
4. Household size (a) 1-3 (b) 4-7 (c) 8-11 (d) 11 and above
5. Are you originally from this village? (a) Yes (b) No
6. If no, where were you living before coming to this village?.....
7. What is your monthly average income in Tshs?.....
8. Source of income of the respondent (multiple response allowed)

   (a) Selling agriculture products (b) Employment salary (c) Remittances (d) Fishing

   (e) Hunting (f) others specify……
9. What is your farm size in hectare? (a) 1-5 (b) 5-10 (c) 10-15 (d) 15 and above
10. What kind of crops do you grow?.....
11. How much was your yield in the last season? Specify per crop

| Type of crop | Yields in terms of bag |
|---|---|
| | |
| | |
| | |
| | |

12. What type of livestock do you keep?……

13. Household has access to media? (a) Yes (b) No

14. If Yes, what type of media your household has access to?.....

**SECTION 2**: **Knowledge and perceptions of changes of climate variables**

15. Are you aware of climate change? (a) Know a lot (b) Know (c) Know little (d) Don't know
16. How do you perceive the status of climate variables in your village? (Tick as appropriate)

| **Local perceptions** | **Tick** |
|---|---|
| Increasing rainfall amount during rain season | |
| Decreasing rainfall amount during rain season | |
| Increasing length of rain season | |
| Decreasing length of rain season | |
| Early onset of rain days | |
| Late onset of rain days | |
| Increase of strong winds events | |
| Increasing temperature of the area | |
| Decreasing temperature of the area | |

17. What are the causes of climate change in your area? (Tick as appropriate)

    (a) Environmental degradation
    (b) Pollution
    (c) Deforestation

(d) Modernization

(e) Others…….

18. What are the impacts of climate change which affects your livelihood activities?

……..

**SECTION 3**: **Learning indigenous knowledge on climate change adaptation**

19. Please mention different sources of knowledge concerning climate change adaptation? (Tick as appropriate)

| **Sources of knowledge** | **Tick** |
|---|---|
| Personal experience | |
| Parents/Family | |
| Friends/Neighbours | |
| Social groups | |
| Church/mosques | |
| Community gathering | |
| Village leaders | |
| Media | |
| Extension staffs | |
| NGOs | |
| Others specify | |

20. For how long you have been using this knowledge in your everyday farming and livestock keeping activities?.....

**SECTION 4: Challenges of indigenous knowledge and practices on climate change adaptation**

21. What are the challenges of applying indigenous knowledge and practices on climate change adaptation (rank them as above in terms of importance)

(a) Intrusion of western knowledge

(b) Inception of government based adaptation strategies

(c) Lack of government support

(d) Disappearance of traditional farming system

(e) Death of IK custodians

(f) Lack of reliable sources or financial income

(g) lack of information on weather

(h) Disappearance of traditional seeds

(i) Shortage of Labour

(j) Extension advice

(k) Less effective

(l) Forgotten them

(m) Elders do not pass them on

(n) New generation refuse their use

(o) There is no hindrance to adaptation

(p) Others please specify……..

22. What are your suggestions which you think will enhance indigenous knowledge practice to effectively adaptation to climate change? Comment freely

……
……

23. Do you have any other opinion that you think will be beneficial to this study?

……
……
……

## Annex 2: Guiding questions for interviews and focus group discussions

(This interview guide will be used only for local leaders, elders, experienced farmers, famous leaders in the community and religious leaders)

### Different on-going changes observed within the community

1 What kind of changes you have observed in recent years in your village?

2 How do local communities explain those changes?

3 Please can you explain the causes of these observed changes?

4 What are the main disasters caused by these changes experienced by local communities in the past 30 years in this village?

### Climate change perceptions

5 Please explain the changes of local climate which you have observed in this village for the last 30 years.

6 On average, how many times/years have you observed unexpected frequent precipitation in the past 30 years?

7 On average, how many times/years have you observed frequent drought in the past 30 years?

8 On average, how many times/years have you observed unexpected strong winds in the past 30 years?

9 Please explain the causes of changes of the status of local climate in this village.

10 What are the impacts of climate change you have experienced in recent years?

### Indigenous knowledge adaptation practices to climate change

11 What are the sources of knowledge regarding climate change adaptation in your community?

12 How did you learn about indigenous knowledge that you in climate change adaptation?

13 Please explain indigenous adaptation practices used by local communities to withstand drought condition.

14 Please explain indigenous adaptation practices used by local communities to withstand reduced precipitation.

15 Please explain indigenous adaptation practices used by local communities to control strong wind events.

16 Please explain strategies used by local communities to control pests and diseases caused by climate change to both crop and livestock.

17 Please explain indigenous knowledge practices on water resources management.

18 What are the sources of indigenous knowledge adaptation practices used by the local communities to adapt to climate change?

**Challenges of indigenous knowledge in climate change adaptation**

19 Do you think indigenous knowledge practices are helpful to adapt to climate change? If yes how?

20 Do you think it is relevant to integrate indigenous knowledge with western knowledge to adapt to climate change? If yes why?

21 Do you think it is relevant to integrate indigenous knowledge with existing government policies and programs to adapt to climate change? If yes why?

22 What are the underlying challenges of using indigenous knowledge practices on climate change adaptation?

23 How these challenges can be solved?

24 What are your suggestions on how to promote indigenous knowledge for effectively climate change adaptation at local level?

**Annex 3: Guiding questions for extension staffs and NGOs experts**

**Climate change perceptions**

1. What are the indicators of climate change you have noticed in this community in recent years?
2. How do you compare the present indicators with the previous indicators of climate change in this community?

**Indigenous knowledge adaptation practices to climate change**

3. What are the methods used to by the local communities to control diseases and pests caused by climate change to both livestock and crop production?
4. Which of the above methods involves indigenous knowledge and which involves western knowledge?
5. What methods of disease and pests control to livestock and crops are no longer applicable to the community?
6. If any, what are the reasons for not being in use?
7. What are the adaptation practices to prolonged drought seasons and reduced precipitations have been developed within the community?
8. What are the sources of these adaptation strategies performed by local communities in your area?
9. Explain indigenous adaptation practices used by the local communities in the face of strong wind events.
10. What adaptation strategies used by local community on water resources management?
11. What are the sources of these adaptation strategies you have mentioned above?
12. Do you think indigenous knowledge on climate change adaptation is relevant to the community you are working?
13. Does training in the community you are working cover both western and indigenous knowledge? If not why?
14. If yes, what is the community response with regard to integration of indigenous knowledge and western knowledge?
15. Which adaptation strategy between indigenous knowledge and western knowledge is most applicable in this community? And why?
16. What type of knowledge do you recommend to local community in adapting to climate change?

17. Do you think it is important to integrated indigenous knowledge with existing government policies and programs on adapting to these changes? If yes, why?
18. What are the objectives of adapting to these changes to local communities?

**Challenges of using indigenous knowledge in climate change adaptation**

19. What are the challenges of applying indigenous knowledge on climate change adaptation?
20. What should be done to overcome those challenges you have mentioned above?

## Annex 4: Guiding questions for government officials and research scientists

### Perceptions of climate change

1. What are the indicators of climate changes observed in this country in recent years?
2. What are the causes of climate change in Tanzania?
3. How climate change affects agricultural and livestock keeping communities in Tanzania?
4. How the incidences of human disease relates to climate change?
5. How the incidences of pests and disease to crops and livestock relate to these changes?
6. How climate change affects water resources management in Tanzania?

### Indigenous knowledge and practices on climate change adaptation

7. What are the indigenous knowledge adaptation practices applied by the local communities to control pests and disease caused by climate changes to both crops and livestock?
8. What are the indigenous knowledge adaptation practices used by the local communities on water resources management?
9. Explain indigenous knowledge adaptation practices used by the local communities to adapt to strong wind events.
10. What kind of support do you provide to local communities for effectively adaptation to climate change impacts?
11. Do you think it is important to integrate indigenous knowledge with western knowledge in adapting to climate change? If yes, please explain the relevance of indigenous knowledge on climate change adaptation?
12. Explain the contribution made by your organization/section on adapting to climate change in the community.
13. To what extent is the use of indigenous knowledge in adapting to climate change is effectively integrated into national climate change adaptation policies and strategies?

14. What should be done to incorporate indigenous knowledge on national adaptation policies and programs?

15. To what extents are the national policies and programs on climate change adaptation have realized the potentials of indigenous knowledge as a remedy to successful climate change adaptation at local level?

**Challenges of indigenous knowledge in climate change adaptation**

16. What are the limitations of applying indigenous knowledge practices on climate change adapting?

17. How those challenges above can be effectively addressed?